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NOTES AND COMMENTS

New International Sugar Agreement.[1]

Representatives of the World's major sugar producing and consuming countries adopted a new International Sugar Agreement at Geneva on October 24th. This new Agreement will replace the present one that expires on December 31st, this year, and will remain in effect for five years. However, at the end of three years it shall be restudied, and open to amendment, in respect of its operation during the fourth and fifth years.

The Agreement will be open for signature, from December 1st to December 24th, 1958, by the Governments represented by delegates at the Conference at which the new Agreement was negotiated.

Among other things, the primary objectives of the Agreement are to assure supplies of sugar to importing countries and markets for sugar to exporting countries at equitable and stable prices.

The new pact will become effective on January 1st, 1959, if ratified by 60% of the importing countries and 75% of the exporting countries, based on votes assigned to each country.

The new Agreement has been strengthened by the addition of Brazil and Peru, two important sugar exporting countries who have agreed to adhere to the plan. Brazilian and Peruvian ratification must still be sanctioned by their respective governments.

For the first three quota years (1959–1960–1961) during which the Agreement will be in force, the exporting countries or areas named below shall have the following basic export tonnages for the free market :

	(In thousands of metric tons raw value)
Belgium (including Belgian Congo)	55*
Brazil	550
China (Taiwan)	655
Colombia	5
Cuba	2,415
Czechoslovakia	275
Denmark	75
Dominican Republic	655
France	20†
Germany, Eastern	150
Haiti	45
Hungary	40
India	25
Indonesia	350
Italy	20
Mexico	75
Kingdom of the Netherlands	40‡
Peru	490
Philippines	25
Poland	220
Portugal (including overseas provinces)	20
Turkey	10
U.S.S.R.	200

* In calculating Belgium's net exports, the first 25,000 tons of exports to Morocco are excluded.

† Because of the links existing between France and Morocco and Tunisia, within the French Franc monetary zone, up to 380,000 tons of net exports by France shall not be counted in arriving at her basic export tonnage.

‡ The Kingdom of the Netherlands undertakes not to export over the years 1959, 1960 and 1961, taken as a whole, a greater amount of sugar than it imports during the same period.

The export quotas of the Czechoslovak Republic, Hungary, and the Peoples' Republic of Poland do not include their exports of sugar to the U.S.S.R. and these exports are outside this Agreement. The U.S.S.R. export quota is calculated without taking into account imports of sugar from the Czechoslovak Republic, Hungary and the People's Republic of Poland in excess of 50,000 tons.

Costa Rica, Ecuador, Guatemala, Nicaragua and Panama, to which no basic export tonnages have been allotted, may each export to the free market up to 5,000 tons, raw value, a year.

A special reserve is established for each of the first three quota years of the Agreement and is allocated as follows :

	(In thousands of metric tons raw value)
China (Taiwan)	95
India	75
Indonesia	50
Philippines	20

Notwithstanding that these allocations are not basic export tonnages, the provisions of the Agreement (other than those in connexion with adjustments) shall apply to them as if they were basic export tonnages.

[1] *Lamborn*, 1958, **36**, 232; C. Czarnikow Ltd., *Sugar Review*, 1958, (378), 185–186.

The various countries within the Commonwealth Sugar Agreement of 1951 have been provided with net exports for the calendar year 1959 of 2,500,000 English long tons (2,540,835 metric tons) *tel quel*; and for the calendar years 1960 and 1961 of 2,575,000 English long tons (2,617,060 metric tons) *tel quel* per year.

The Agreement, among other things, also provides for limiting and holding stocks under certain conditions; the stabilization of world sugar prices within a range of a minimum of 3·15 cents per pound and a maximum of 4·00 cents per pound and by the adjustment of quotas to meet market conditions.

A new article—No. 22—has been added to the agreement which reads as under :—

(1) During the first quota year of this Agreement, the Council shall consider, and make recommendations to interested participating governments concerning the negotiation of arrangements for multilateral options drawn up in accordance with the provisions of this articles.

(2) Such arrangements shall be designed to secure that, if the prevailing price moves beyond the highest or lowest price of the range set out in Article 21, the participating governments concerned will have the right to exercise options for sale or purchase, as the case may be, in respect of such quantities of sugar as may be prescribed in the arrangements.

(3) The options shall be exerciseable in accordance with such limits as to time and frequency, or otherwise, as may be prescribed in the arrangement.

(4) The arrangements shall take into account the traditional pattern of the trade in sugar.

(5) The Council may establish such Committees as it deems desirable to assist it in the examination of these questions and to formulate the recommendations provided for in paragraph (1) above.

It is reported that the Council unanimously adopted a resolution that consideration of this article on multilateral options should be placed on the agenda of the first meeting in 1959 of the Council.

Provision is made for a more prompt declaration of quota deficits, and member governments of those countries which are is a position to do so agree to notify the Council of such deficits not later than 15th May so that a redistribution can be made before other exporters have stopped producing. Those countries which are unable to assess their prospects so early in the year agree to notify the Council as soon after that date as possible but not later than 30th September.

The sugar council can now revise the initial export quotas, in total and then individually, by April 1st each year; it can thus take full account of the European crop of beet sugar, which is apt to be one of the main variables in its estimates of supply and demand.

The Council is to meet when the world price reaches 3·75 cents to decide how much quotas shall be increased. If no agreement is reached, there is to be an automatic increase of 2½%. Further, stocks are to be more stringently controlled by the Council. Stocks of 10% minimum and 20% maximum of basic export quotas are to be kept by producers to be made available immediately as and when called for by the Council. Commonwealth producers guarantee stocks will not be less at any one time than a total of 50,000 tons.

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Indian Cooperative Sugar Mills.[1]

It was announced in the Lok Sabha on 2nd September that the Second Indian Five-Year Plan provides for the establishment of cooperative sugar factories in the States of Andhra Pradesh, Assam, Bihar, Bombay, Madhya Pradesh, Madras, Mysore, Orissa, Pondicherry, Punjab, Rajasthan, Uttar Pradesh and West Bengal. The Government of India has decided to give aid for the purpose of setting up the factories at the rate of Rs. 15 lakhs (£112,500) per factory subject to a matching contribution by promoters.

Cooperative sugar factories become eligible for such assistance only after they have been licensed under the Industries (Regulation and Development) Act and have been granted an import licence. So far during the Second Five-Year Plan the Government of India has provided assistance to cooperative sugar factories in Assam, Bombay, Madras, Punjab and Uttar Pradesh.

* * *

Indian Sugar Crop 1957/58[2].

Final figures in respect of the 1957/58 season have been received and are detailed below.

Decreases in acreage occurred mainly in Uttar Pradesh, Bihar and Madhya Pradesh due to unfavourable weather conditions during the planting season. This was to some extent offset by increases in Bombay, Mysore and Punjab States.

Adverse weather in the growing period accounted for a part of the decline in production.

	1957/58 *Final Estimate*	1956/57 *Revised Estimate*
Area, acres	5,021,000	5,057,000
Cane Production, tons	63,954,000	66,998,000
Sugar Production, tons	6,367,000	6,751,000

It is to be noted that the second five-year plan aims at a production of cane in 1960/61 of 78,000,000 tons. The white sugar production target is 2,250,000 tons.

The first estimate of the area under cane during the 1958/59 season, at 4,795,000 acres, shows a sharp reduction from the previous season's final estimate of 5,021,000 acres. The adjusted first estimate for 1957/58 of 5,031,000 acres turned out to be very near the final figure.

Unfavourable weather was experienced during planting time in Uttar Pradesh and Bihar where the main decreases in sowing occurred.

The above estimate which covers roughly 94 per cent of the area of the crop finally reported reflects the position as at the middle of June. Up to that time the general condition of the crops was said to be satisfactory.

White sugar production of the 1957/58 crop totalled 1,967,516 tons up to the 22nd August. Despatches to the same date amounted to 1,646,501 tons.

[1] *Indian Trade J.*, 1958, **205**, 814.
[2] C. Czarnikow Ltd., *Sugar Review*, 1958, (377), 183.

RECENT PROGRESS IN BREEDING SUGAR BEET

By Dr. S. ELLERTON, Ph.D. (Bush Johnsons Ltd.)

SUGAR beet is very unusual among crop plants in that it is of recent origin and has been the subject of scientific plant breeding work from the outset. Nearly every other crop grown by man has been in cultivation for some thousands of years and has, during that time, been the subject of natural selection and has been moulded by the crude selection processes of primitive man. When the modern plant breeder appeared on the scene, these crops were, in fact, more or less ready-made. Sugar beet, on the other hand, was from the outset developed by deliberate selection. The need for it arose as a result of chemical discoveries in the latter half of the eighteenth century and it was realised from the beginning that the economic extraction of sugar from beet depended upon the availability of a type of beet with high sugar content. The chemical process and the crop plant were, in fact, interdependent and the work of the sugar beet breeder has been of vital importance to the beet sugar industry throughout its history.

The effect of intensive plant breeding on the sugar beet crop throughout the 180 years or so of its existence has been quite interesting. At the outset, progress was delayed by the fact that there was no quick and easy way of estimating the percentage of sugar in a root, so that it was difficult to select high-sugar roots. This situation was changed in the middle of the nineteenth century when the polarimeter was invented, and rapid improvement resulted from the use of this instrument. Another early difficulty was that the results of single root selection were sometimes disappointing and it was realised by LOUIS DE VILMORIN that this was because a single root could appear superior either because it had a superior heredity or because it had been lucky in its environment (for instance it might have had more growing space than its neighbours or might have escaped disease). DE VILMORIN, also about the middle of the nineteenth century, invented the progeny test to circumvent this difficulty, and this method, first applied to sugar beet, is now standard procedure for plant and animal breeders throughout the world. A further rapid improvement followed this technical advance.

The exact effect of the introduction of the progeny test and the use of the polarimeter is obscured by the fact that, at much the same period, sugar beet breeders had a stroke of pure fortune (every plant breeder fully realises, of course, that whatever he does he still needs to have quite a bit of good luck if he is to select real winners). Somewhere in Holland, it appears, a fodder beet cross-pollinated naturally with a wild sea beet and the progeny of this hybrid contained a root or roots which some unknown person recognized as being superior. This beet was eventually seized upon by every sugar beet breeder and became known as the Imperial beet. This beet has entered largely into the ancestry of modern sugar beet varieties.

By the end of the nineteenth century the main gains in sugar beet breeding had been made. As varieties improved, it became increasingly harder to effect further improvement and often the gains to be expected from the selection of superior individuals in successive generations were counteracted by an increasing degree of inbreeding. Improvements were made in detail, for instance in resistance to bolting or in resistance to leaf-spot disease. A " plateau " appears to have been reached, however, in sugar production. This " plateau " was probably pushed a little higher when, in the 1920's and 1930's, methods of inbreeding and recombination were applied to sugar beet, analogous to those which had so successfully led to the production of hybrid maize in America. Sugar beet is not nearly such a convenient plant as maize for this purpose, however, and it is uncertain exactly what further gains were achieved. Certainly they were not great.

By the 1940's there were many varieties of sugar beet on the world market. Some were designed for special situations, as in America, where varieties resistant to specific diseases were developed. Some were undoubtedly inferior, for sugar beet breeding may very easily be mismanaged. There was, however, very little to choose between the best varieties and very little evidence that the efforts of breeders were leading to any further increase in sugar per acre. Breeders were, by and large, well and truly stuck.

It was into this situation that several quite new possibilities entered. One line of advance, polyploidy, was exploited in Europe, while another, male-sterility, was worked on in America. It now appears clear that a combination of these two new techniques offers the first chance of a really big advance in sugar beet varieties in this century.

All plants, of course, consist of cells and each cell contains a specialised part, the nucleus, which carries the hereditary factors. These factors are carried in minute bodies within the nucleus called chromosomes, which appear clearly when a cell is dividing. It has long been known that the number of chromosomes is characteristic of a species. In many cases, however, related species have different multiples of the same basic number ; 12, 18, 24, 30 or 14, 28, 42 for example. This applies to some of our crop plants as well as to wild plants, and the higher numbers are known as polyploids.

Our bread wheats and our cultivated potatoes, for example, are polyploids, and are undoubtedly successful. Many polyploid wild species are outstandingly successful and have been able to colonise areas where the ancestral species could not survive. Perhaps, thought some breeders, if we could manufacture a polyploid sugar beet it, too, would be superior.

The difficulty was that, until 1936, methods of producing polyploids artificially were difficult and rather uncertain. Then, arising indirectly out of cancer research, came a new and convenient method. The drug colchicine (traditionally used in the treatment of gout) was found to produce polyploids more or less to order, and breeders in Denmark, Sweden and Germany set about producing sugar beet with 36 chromosomes instead of the normal 18.

It was soon found, very disappointingly, that 36-chromosome (" tetraploid ") sugar beet was inferior to the normal type. However, it was soon also found that if this new type was crossed back to the normal type, sugar beet with 27 chromosomes (" triploid ") resulted and that this triploid type was superior to either parent in the cross. Triploid sugar beet was, however, sterile. It therefore had to be produced afresh in each generation by crossing the 18 and 36 chromosome parents—a little bit like breeding mules.

This technique was soon put to commercial use and " polyploid " varieties of sugar beet appeared on the market. It was clear that the ideal polyploid sugar beet variety would consist entirely of 27-chromosome plants (" triploids "). This, however, was unattainable, since all that could be done was to grow together seed plants of the 18- and 36-chromosome varieties and allow them to interpollinate. To some extent, 18-chromosome plants would pollinate 36-chromosome plants and vice versa. This would give the desired 27-chromosome triploids. Some pollinations would, however, be between pairs of 18-chromosome plants or, on the other hand, between pairs of 36-chromosome plants. These pollinations would give 18-chromosome (diploid) and 36-chromosome (tetraploid) progeny respectively. " Polyploid " sugar beet varieties therefore consist of mixture of diploid, triploid and tetraploid plants. They do, in general, show very useful advances in sugar yield over conventional (diploid) varieties, but by no means fully realise the high yield of a pure triploid variety. They contain maybe 30 or 40% of diploid plants which are merely normal sugar beet, and therefore dilute any advantage that polyploidy might bring. They also contain perhaps 10 or 20% of tetraploid plants which are inferior. In spite of this, " polyploid " varieties are now commercially important in Europe and in recent years have, in general, been heading the list of varieties in official variety trials.

Before leaving the subject of polyploidy, it is interesting to note that improvement in sugar cane varieties in this century has also been largely a matter of increasing chromosome number. Here, however, no problem of reproduction arises since the crop is propagated clonally.

In America, this line of advance has not so far been seriously followed. On the contrary, efforts have been made to make the sugar beet plant a more convenient one for use in the production of commercial hybrids, corresponding to maize hybrids. A type of sugar beet was discovered in which no pollen was produced. This was known as a male-sterile beet. It was fertile on the female side, so that when pollinated by a normally fertile plant it could set seed. For the most part, such pollination led to the production of progeny which were no longer male-sterile, so that this useful character was lost. Extensive search, using a test-crossing method, led, however, to the discovery of individual plants which, when used as pollinators of male-steriles, gave progenies in which all the plants were in turn male-sterile. These special pollinators are known as O-types and they can only be detected by test-crossing. The breeding problem is rather like that of breeding dairy bulls.

The upshot of this work is that sugar beet inbreds now exist in a form in which completely controlled crossing is possible. Double crosses can in turn be produced, exactly comparable genetically to double-cross maize hybrids. The method is, in fact, so convenient that search has since been made for male-sterile maize types and the breeding method devised in order that the sugar beet breeder could imitate the maize breeder, has in turn been adopted by the maize breeder.

Controlled crossing in sugar beet, and the development of suitable inbreds, may be expected to lead to very considerable increases in sugar yield and in uniformity, and American workers are talking about a 15% increase in yield. The work involved is, however, very great indeed. Very many inbreds must be developed and then they must be tested in an astronomical number of crosses in order to identify the particular combination of inbreds which " nick in " together. This work clearly has a long way to go.

The really great advance in sugar beet breeding which is now possible comes from a combination of the two techniques of polyploidy and male-sterility. " Polyploid " varieties as they exist today consist, as we have said, of a mixture of diploid, triploid and tetraploid individuals. If we can so arrange it that one of the two parent varieties used in the production of polyploid seed is male-sterile, and we then harvest the seed only from that parent, we should theoretically be able to get seed which is 100% triploid. This would have two advantages ; firstly, it would consist entirely of plants having what appears to be the ideal chromosome number for beet. Secondly, the plants would all be hybrid and would have the advantage of hybrid vigour. Work on the production of pure triploid varieties of sugar beet was started some years ago in Europe and proved quite difficult, since new O-type pollinators of European varietal type had to be developed for use in the repeated back-crossing of the originally American male-steriles. This work has now reached fruition, however, and Bush Johnsons Limited in England, together with the Dutch firm of D. J. van der Have, N.V., who have co-operated in the research, placed the world's first triploid sugar beet variety on the market in limited quantity this year. A much larger amount of this type of seed will be available in 1959 and trial results in various countries have fully borne out its promise. Its sugar yield is considerably in advance of all other varieties. Clearly, however, much detailed work still remains to be done and the possible limit of yield from the use of this method has not yet been realised.

Further work is now in hand for the production of pure triploid varieties suitable for American conditions and in particular for those parts of the world where *Cercospora* leaf-spot is a serious disease of sugar beet. This work is being done by the above two companies in collaboration with the Great Western Sugar Company of Denver, Colorado, and this combination of companies is also engaged on the production of triploid sugar beet varieties which are also monogerm. These latter varieties will have only one true seed in each seed ball and will be specially suited for use in precision drills. It is eventually hoped that such seed, together with advanced methods of chemical weed control, will make it possible to grow very high-yielding sugar beet entirely without hand labour.

THE SUGAR CANE IN BRITISH GUIANA

SUGAR Bulletins Nos. 24–26, covering the years 1955, 1956 and 1957 respectively, follow the same pattern as previous Bulletins with successive sections dealing with Field Experiments, Variety and Fertilizer Position and the Report of the Sugar Experiment Stations.

Field experiments cover variety, fertilizer and cultivation trials together with growth and ripening studies. The variety trials, numbering 89 as they do in the latest year, can only be briefly outlined, for they include sorting, plant cane and both first and second ratoon trials on the four major soil types, Demerara and Berbice frontland clays, riverside clay and pegassy clay. In the larger trials B 41227, which occupies some 33% of the total area, is taken as standard, though B 37161, at 43%, is still the leading cane. Recommendations for planting based on the data obtained would raise the area under B 41227 to some 55% and reduce that under B 37161 to between 20 and 25%. The area under B 47258, now only some 5%, would be raised to 20%. The remaining 5% would be devoted to small-scale plantings of B 45137, B 46378, B 4362 and D 141/46. During the period covered by the Bulletins a large number of seedlings were imported and passed to the sorting trials.

The 10 fertilizer experiments, in like manner, are too many to be dealt with in detail. Perhaps those of greatest interest concern the function of lime. Lime appears to increase the availability of phosphate and potash when these are deficient, but the consistent, if not statistically significant, increased yields from lime dressings when both phosphate and potash are present in adequate quantity must be attributed to some other cause or causes. Suggested causes are calcium as a direct nutrient, reduction in the level of magnesium and manganese or reducing the absorption of iron when present in toxic concentrations. With respect to nitrogen, a significant yield increase was obtained in the first ratoon crop, as earlier recorded for the plant crop, from 141 lb N per acre, but with no significant difference between the forms of supply: urea, ammonium chloride, ammonium nitrate, di-ammonium phosphate or ammonium sulphate. Broad results only were obtained from variety cum fertilizer experiments; these suggest that B 41227, B 37161 and D 37/45 are capable of using more nitrogen than B 4362 and B 4098.

The first cycle of an experiment comparing the Cameron–Williams system of cultivation with the standard method has been completed and the results are discussed in Bull. 24. The system has been described in some detail earlier.[1] The improved yield in the plant cane crop is attributed to the better drainage, and no mention is made of any effect attributable to the accumulated trash, the use of which was one of the original objectives in designing the system. Failure to obtain increases in the ratoon crops is attributed to the fact that, as the drill deepens to its full depth of 2 ft, the plant is earthed up with saline sub-soil. The better drainage should, in time, remove this, leading to a salt-free soil of 2 ft. In this expectation the comparative experiment is being continued as a long-term experiment.

The three Bulletins deal successively with the plant and two ratoon crops from the aspect of growth and ripening. The tons of 96° sugar/acre and the pol % cane of the four varieties B 41227, B 37161, D 37/45 and D 158/41 are determined at successive intervals between the ages of 10 and 15 months (Sept. to Feb.) and compared. There are marked differences in the varietal reactions. Such factors as variability in number and growth rates of stalk categories (primaries, secondaries etc.), age at which arrowing occurs, rapidity at which changes in growth take place, all influence the result and, superimposed, are the vagaries of the weather, in particular the rain-fall. Forecasting, under the circumstances, must be a very difficult, perhaps impossible, task.

Leaf scald, *Xanthomonas albilineans*, was first identified in British Guiana in the autumn of 1950 and soon assumed epidemic form. Its history from that date to 1956 is briefly traced in Bull. 24. In 1951, with commendable promptness, varietal resistance trials were instituted; B 37161, B 41227 and B 4098 were soon identified as tolerant and, by 1953, the area under susceptible varieties fell from 60,000 to 44,000 acres with a further fall to 13,000 acres in 1955. This replacement has made considerable alterations in varietal distribution. B 34104 which, in 1951, occupied 67% of the total area, occupied only 2·9% in 1956. Nevertheless, there is a long road to be travelled before the disease will be brought under control. So far, commercial varieties are only susceptible-tolerant or tolerant. Bull. 26 includes a statement of the ratings of a large number of varieties of which 45, all Barbados seedlings, are rated as resistant. H.M.-L.

[1] *I.S.J.*, 1943, **45**, 93.

RECENT WORK IN INDIA

INTEREST at the 25th Annual Convention of the Sugar Technologists' Association of India, 1957, was concentrated mainly on non-agricultural aspects of the industry. As pointed out by R. D. REGE,[1] in evaluating the results of agricultural research, too much stress has been laid on yield of cane per acre as against yield of sugar. The difficulties inherent in the problem of payment for quality under the conditions of Northern India, where cane is grown in minute plots, are discussed by S. C. SEN in a paper, "A Plea on the Application of Hand Refractometer in Assessment of Cane Price on Quality". A method of field sampling in ¼-acre units is described which gives sufficient accuracy, but sampling is not the only difficulty. Transport limitations on the amount of cane which can be drawn from one zone to another in a limited period raise problems in the issue of the *purzies* described below. The subject is again discussed, and in further detail, by S. C. SEN and D. R. HANDA with especial reference to conditions in Rohilhand. Separate ready reckoners have been worked out which give a satisfactory prediction of the recovery % cane from the middle internodal brix of the standing cane for the three periods, November/December, January and February/March.

The objectives in the above are two : payment to the cultivator for quality and insurance that cane is cut at the optimum maturity. In a further paper, "Automatic Juice Sampling Arrangement for Cane Quality Scheme", R. C. SHARMA describes a somewhat complicated, electronically-controlled device for collecting samples of primary juice from the relatively small consignments which may be fed to the crushers. In yet another paper by S. N. GUNDU RAO and N. C. VARMA entitled "Payment of Cane Price on Quality Basis," a practical attempt to implement such a scheme is described. The scheme was operated at 9 mill centres in 1956–57, the minimum load to be sampled was from 4–5 bullock carts and 2–3 lorries or wagons, and, in certain cases, the sampling was conducted with the device described by R. C. SHARMA. Operation of the scheme was, wisely, on an experimental basis and designed primarily to find out the obstacles to its smooth running. These appear to lie more in the field organization than in sampling at the factory, the grouping of the smaller growers to build up analysable loads and in the issue of *purzies*, or cutting orders, which would ensure both the cutting at optimum maturity and a steady flow to the factory.

Cane Breeding.—A single paper by M. LAXMIKANTHAM and K. K. PRASADA RAO describes the results obtained in a study of parental influence in the case of germination, stalk population at harvest, peak sucrose content and yield. The most promising varieties for use as male or mother parents are indicated.

Cultural Problems.—The only paper touching on cultural problems is one by S. C. SEN describing a small-scale experiment designed to trace the effect of spraying hormones and certain other solutions, such as molasses and ammonium sulphate and super-phosphate mixture, on final yields. The results indicated the effects to be insignificant.

Certain other cultural studies have been recorded in recent issues of *Indian Sugar*. Sirdar W. SINGH[2] compares single bud planting in both single and double rows with the standard 3-bud setts also in single or double rows. The results suggest that there is little to be gained by single bud planting on a commercial scale but that it is of value for rapid varietal multiplication.

Starting from the basis that cane stored up to 6 days shows more rapid germination—an effect attributed to inversion giving a readily available supply of glucose—R. MUTHUSWAMI and P. ARAVAMUDHAN[3] compared stored and fresh cane, both with and without treatment with "Aretan." Better germination was obtained both from storage and from "Aretan" dressing. In a further article[4] the same authors discuss the beneficial effect, both in hastening germination and as an insecticide, of "Aldrin" and certain other substances such as "Chlordane" and "Dieldrin."

A new problem has arisen in Bihar in that the rapid increase of area under cane gives a crop above factory requirement. A study by R. K. TANDON and R. L. BHOJ[5] suggests that it may pay to harvest stand-over cane, the controlling factors being the variety and its adaptibility to the soil conditions.

A last article[6], by S. K. CHOPRA, in brief terms offers recommendations, embodying the latest findings, for cane culture in Uttar Pradesh.

Pests and Diseases.—A single paper only was presented to the Congress under this heading, one by D. V. MURTHY on the pink borer (*Sesamia inferens*) in Hyderabad. Its control by cultural methods such as earthing up is unsatisfactory and difficulty is added to by the fact that the pest also attacks *jowar* (*Sorghum*).

In *Indian Sugar* R. A. AGARWAL[7] describes the sugar cane mite (*Schizotetranychus andropogonii*), normally a minor pest in Southern India, but capable, on occasion, of causing considerable injury, especially to types of *S. spontaneum*. It appears to be particularly immune to the commoner insecticides, and "Folidol" alone gave appreciable control up to 13 days.

B. D. GUPTA and P. N. AVASTHY[8] describe a new beetle pest (*Lachnosterna consanguinea*) in Bihar. In 1956, the damage caused in one factory area was

[1] *Indian Sugar*, 1957, 7, 575.
[2] 1957, 7, 400.
[3] 1957, 7, 402.
[4] 1957, 7, 523.
[5] 1957, 7, 467.
[6] 1957, 7, 527.
[7] 1957, 7, 394.
[8] 1957, 7, 587.

extensive ; the life history, therefore, was studied and tentative chemical control initiated. The life history is similar to that of the greyback in Australia in that the adults, on emergence, take themselves to trees, particularly *Ficus glomerata*. The grubs appear immune to all insecticides but "BHC".

Red rot is dealt with in an article by P. P. MEHTA and R. N. SINHA[9]. They find primary infection through the sett the major source and are in agreement with the findings of KIRTI KAR and D. D. SRIVASTAVA[10] that fungicidal treatment of setts is no protection against the disease. H.M.-L.

AGRICULTURAL ABSTRACTS

A Review of Variety × Fertilizer Tests Harvested during 1955–56 and 1956–57 Crop Years. F. T. TABAYOYONG and F. A. BASILA. *Victorias Milling Co., Expt. Sta. Release*, 1958, (20), 27 pp.—Using POJ 3016 as standard, CP 29/116 gave an increase of 44% sugar/ha with the most profitable yield from 120–100–180 kg/ha ; Co 440 with 37%, and Co 449 with 36% increases, the respective optimal fertilizer dressings being 150–120–240 and 120–100–180 kg/ha.

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The Physiology of the Deterioration of Stored Cane and the Effect of 2,4-D. V. S. TRIPPI. *Rev. Indust. Agric. (Tucumán)*, 1957, **41**, 3–14.—Deterioration under dry conditions of storage is more rapid, due to a concentration of juice which favours inversion, and is particularly marked when cane is directly exposed to the sun. 2, 4-D has an inhibiting effect on inversion but it is more profitable to prevent water loss by covering with trash or even compensate for the water losses by addition. * * *

N : Co 310 and the Sugar Industry of Taiwan. H. W. LI. *Taiwan Sugar*, 1958, **5**, (4), 13–19.—N : Co 310 was introduced to Taiwan from South Africa in 1947 and released in 1952. It formed over 90% of the 1956–57 crop. The factors which have led to this remarkably rapid development are reviewed. * * *

A Comparative Study of Water Relations of Drought Tolerant and Drought Susceptible Varieties of Sugar Cane. N. G. DASTANE. *J. Aust. Inst. Agric. Sci.* 1957, **23**, 346–347; through *Plant Breeding Abstracts*, 1958, **28**, 3239.—These studies were conducted at Brisbane ; the varieties in descending order of efficiency with respect to water economy were CP 29/116, Q 47 and Pindar. When subjected to various unfavourable treatments such as frost, heat and submergence of roots, Q 47 appeared to be more hardy than CP 29/116 ; it is stated that cell size is associated with hardiness.

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The Possibility of Improving the Structure of Venezuelan Clay Soils. G. FRANCO. Bol. *Esta. Exp. de Caña de Azúcar de Occidente*, 1957, (65), 28 pp.—The Bulletin is a report by the author on a two months' study of soils, in particular, the clay soils. After a general account of the range of soils met with in the country and the normal methods of cultivation adopted with a view to improvement, such as drainage and subsoiling, he proposes a programme of spreading "Flotal" in April followed by ploughing, a second application of "Flotal" and harrowing ; sowing *Crotalaria* in May to be ploughed in to a depth of 25–30 cm in July; harrowing—in a third application of "Flotal" in August and, finally, planting cane in September. * * *

Deep Tillage. ANON. *Agricultural Research* (U.S.D.A.), 1957, **6**, (4), 4–5.—A very brief account is given of a study in soil stabilization in the heavily eroded, soil-blown areas of Kansas. The objective is to produce a clodded surface and the major method is chiselling or sub-soiling at an appropriate depth. Stress is laid on the importance of correct speed in carrying out the operation and emphasis is laid on the need for adapting the exact method to the particular local circumstances.

* * *

Sugar Cane Variety Tests in the Victorias Milling District, 1954–55 and 1955–56. F. T. TABAYOYONG. *Sugar News* (Philippines), 1958, **34**, 233–240.—The fact that H 37–1933, the standard cane of the district, suffers severely from leaf-scorch is the cause of an intensive search for a replacement variety. Two varieties, H 44–3098 in 35 tests and CP 29/116 in 19 tests, outyielded H 37–1933 by 36·12 and 16·54 tons sugar/ha; N:Co 310, H 39–3633 and Q 50 also showed promise, but each showed certain disabilities and the satisfactory variety has yet to be found.

* * *

Root Investigations and Cultivation Practices in Java. P. WITTEVEEN. *Comm. Assoc. Java Sugar Technologists*, 1958, (4), 5 pp.—The peculiar circumstances under which cane is grown in Java, entailing as they do a short growing season and early maturation period, make it more than usually essential that an early and rapid germination should be followed by unchecked growth, and agricultural practices, particularly earthing up, are directed to securing that objective. Of primary importance in this is vigorous root growth. Such growth offers a difficult study and a method is described of evaluating its extent, the three units of which are : utilization per root band (URB) or the percentage of germinated root primordia, root intensity per band (RIB) or the number of surviving roots at each band, and root intensity per stalk (RIS), which is the product of the two former. Determinations are on a 9 month stool and, together with a profile study, indicate the probable cause of maladjustment.

[9] 1957, **7**, 337. [10] 1957, **7**, 333.

BOOKERS NEW DISTILLERY IN BRITISH GUIANA

RECENTLY put into full production in British Guiana, at Uitvlugt Estate, is a complete new distillery of the most modern design. This not only replaces the old original two-column still but allows for a very great increase in annual production of Demerara Rum. Much careful thought, designing and planning was carried out before the final plans for the distillery were approved, particularly as the plant had to be most versatile in the types of rum and alcohol to be produced.

The distillery had firstly to be able to produce high-strength rum without any change from the original which might have an adverse customer reaction, together with various grades of 96% alcohol for pharmaceutical and industrial purposes and for the manufacture of gin. Rums of various strengths and purities were also required.

The raw material used in the old distillery was final molasses of an average 80° Brix ; this when diluted and fermented produced a wash of 4·5–5·0% alcohol on average, adventitious fermentation being carried out in open wooden vessels. Distillation was carried out by a simple two-column still (analyser 16 plates, rectifier 26 plates). The variations of the products possible from this still were very limited, only partial heads separation being possible.

The first decision was that an efficient still should be designed to operate under all these circumstances and demands and that the alcohol content of the fermented wash should be increased from the customary 4–5% to an average of 7%. This was to be effected by the following innovations :

(i) Use of culture inoculations of the most desirable yeast types instead of adventitious fermentation.

(ii) Use of closed all-steel fermenting vessels of 15,000 gallons capacity each.

(iii) Control of fermentation temperature, thus allowing greater fermentation efficiency. The final temperature in the old plant of 98–102°F inhibited yeast action. Keeping the temperature down to a maximum of 90–92°F would allow more complete utilization of available sugars by the yeast.

It was assumed that with these improvements in control of yeast type and therefore fermentation product, and with the increased alcohol content of the wash, all the fore-mentioned varieties of product could be obtained from a well-designed distilling plant.

Tenders for the above plant and specifications were issued in April 1954 and in October 1954 Messrs. Lepage, Urbain & Cie., of Paris were awarded the contract for all the distillation plant, fermentation plant and ancilliary equipment, whilst the contract for the complete distillery building and fermentation tanks was awarded to the South Durham Steel and Iron Co. Ltd.

Foundation clearing commenced on a new site adjacent to the sugar factory in June 1955 and in July 1957 the distillery was completed in all aspects and trial distillations were carried out, culminating in full production trials in September—November 1957 and full scale commercial production in 1958.

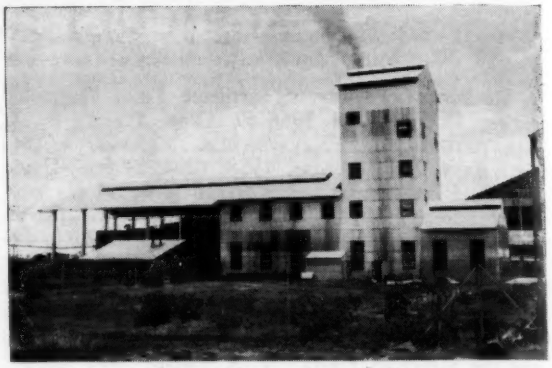

Fig. 1.

Distillery Building

Due to the very soft type of subsoil of which the front lands of British Guiana consist, much thought had to be given to the effective use of preliminary piling of the foundation area. This was done by the use of 40 ft greenheart piles for the distillation tower foundations and 25 ft greenheart piles for the remainder of the building. Approximately 4,000 tons of aggregate were used in the foundations and aprons. The complete building is of all-steel structure, all floors are of "Durbar" steel plate and roofing and side-sheeting of 20-gauge aluminium corrugated sheet.

Raw Materials and Essential Services

Molasses.—Final molasses is pumped from the sugar factory to two 50,000 gallon storage tanks (this storage capacity is now being increased). The molasses is pumped from these main tanks to a ground floor holding tank in the distillery. From this tank the molasses is again pumped to a small overhead feed tank on the top service floor, i.e. the 80 ft floor.

The molasses is then allowed to flow by gravity to a "Libra" automatic weighing scale from which it is then passed via a molasses feed tank to the continuous wash mixer where it is mixed with sulphuric acid (for pH control) and ammonium sulphate (yeast nutrient) and water so that the initial specific gravity of the wash is 1·075. This mixture is prepared continuously by means of a helical agitator and is under constant pressure in the vessel by reason of a 60 ft head of water the feed tank for which is situated on the top service floor.

From this vessel the final mixed wash is fed to the main fermenting vessels and also to the four pre-fermentation tanks for the production of yeast for feeding to the main fermenting vessels.

Water.—Water is drawn from the main Estate service canal before it is allowed to reach the vicinity of the factory, thus ensuring a minimum of pollution from factory effluent, etc. This water originates from the West Coast conservance, a shallow reservoir, nearly 100 square miles in area, which supplies the

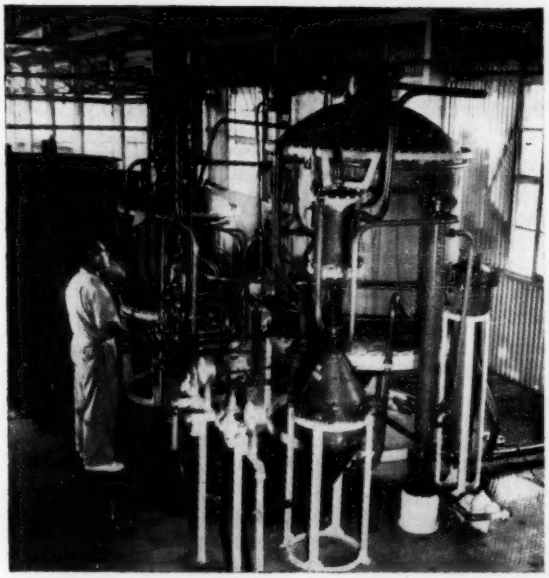

Fig. 2. Pure yeast cultivation tank

whole of West Demerara with water. The condenser effluent and hot spent wash from the distillery is discharged to a canal through which it runs out into the Atlantic Ocean.

Electric Power.—This is taken direct from the factory 415 V, 5-cycle 3-phase system. All electrical wiring, fittings, starters, motors, etc., are Flame-proof Category Group II.

Steam Supply.—This is taken by direct line from the 120 p.s.i. factory main to a steam distribution chest. From this it is led to the main regulators of the distilling columns. A reducing valve on a second line supplies the whole prefermentation and fermentation system with low pressure steam for sterilization.

Compressed Air.—This is taken from the main factory supply at 100 p.s.i. through a reducing valve and air filter before use in the yeast culture plant.

Pre-Fermentation

Yeast Cultures.—These are originated in a fully equipped laboratory with all facilities for the isolation and propagation of any desired yeast strain. From the laboratory, 500 ml quantities are taken to the main distillery building where this quantity is aseptically added to the smallest sterilized vessel of the Savalle yeast culture plant. This small quantity of yeast is then grown within a very short time, with the aid of steam, air, attemporators and other agents, to a quantity sufficient for the inoculation of the four 500 gallon yeast tanks, whence it is directed to any one of the eight main fermenters.

Yeast nutrition and bactericidal agents.—Owing to the poor mineral content of the molasses available, a certain quantity of ammonium sulphate is added to the wash ; this is done through the agency of a proportioning pump. Sulphuric acid is also added at this stage to ensure a suitable pH of the medium for satisfactory growth and action of the yeast together with a depression of the bacterial count of the raw wash. (The molasses in this distillery is not sterilized).

Fermentation

The final mixed wash at pH 4·0 and S.G. 1·075 is sent to the eight 15,000 gallon mild steel fermentation tanks at the particular rate at which the distilling plant is working, depending on the type of product under manufacture. As mentioned above, yeast is added and fermentation takes place immediately.

The CO_2 given off is collected by means of conical covers and an overhead collection system. It is led

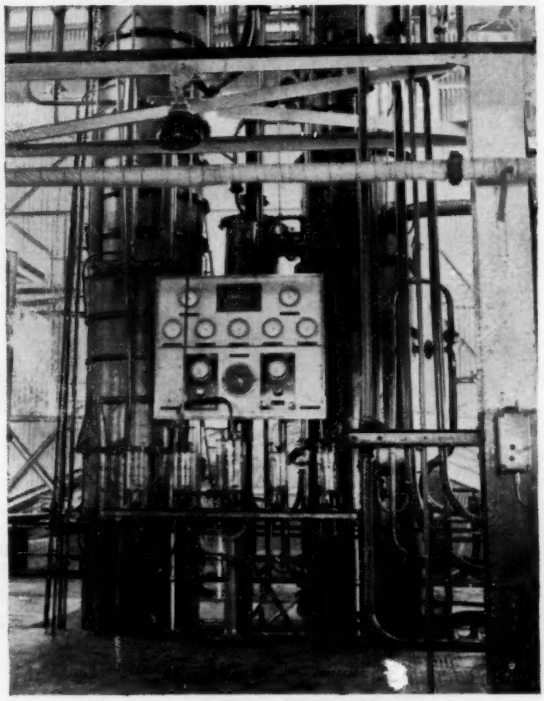

Fig. 3. Control floor.

by its own pressure to a packed-column washing tower from which washed CO_2 is vented (at the present time) to the atmosphere while the washing water plus the recovered alcohol is run back to the wash feed tank. The alcohol thus recovered amounts to 1—2% of the total available in the fermented wash.

Fermentation temperatures are closely studied and recorded in each tank together with the time for fermentation. The alcoholic content of the wash is also continuously checked. Within 48 hours each tank has fully attenuated from an original gravity of 1·075 to 1·030. The tank is then finally checked for alcohol content which should average 7·0%.

From the main fermenting tanks the fermented wash is pumped to a 1000 gallon overhead feed tank ; this is kept at a constant level, thus ensuring a constant head of wash feed to the distilling columns. Wash feed rate is controlled by use of sensitive valves and is preheated by two main vapour condensers.

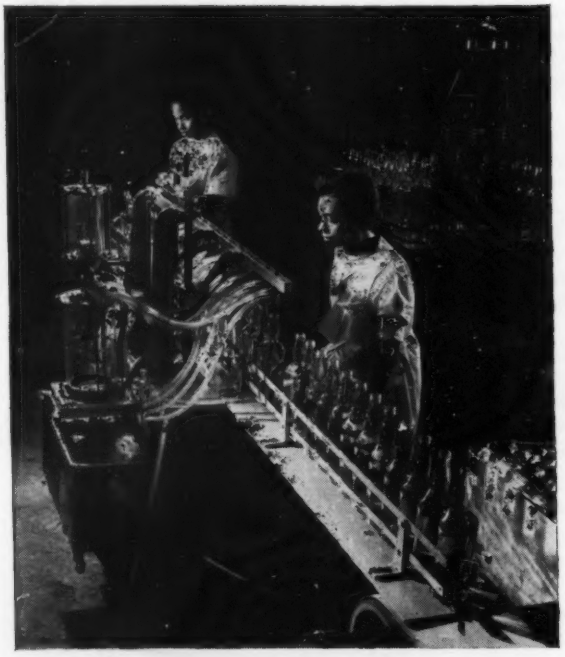

Fig. 4. Bottling plant

Distillation

The design of a distilling apparatus to produce such a large range of rum types as was specified naturally will be very much more complex than that of a still for one or two products. Basically it consists of four separate distilling columns :

(1) Purifying column.
(2) Analysing column.
(3) Rectifying column.
(4) Heads concentration column.

The purifying and analysing columns are of 10 and 16 plates respectively, consisting of Lepage patented inverted-trough-type caps. The sections between each plate have glass main doors to allow easy inspection and cleaning without the necessity for dismantling the column.

The rectifying and heads concentration columns consist of close-set plates, 58 and 10 respectively, the rectifying column having 45 plates in its top section and 13 plates for its stripping section. The condensers for all the above columns are inter-connected and are designed to give minimum steam consumption at any setting. In addition, a complex system of refluxing allows for maximum versatility with regard to flavour and strength of the particular end-product.

Below are given, by way of example, methods of operating the plant for (i) Extra Neutral Spirit at 68 o.p., and (ii) Low-strength rum at 60 o.p.

(i) *Extra Neutral Spirit at* 68 *o.p.*—All four columns are used ; the preheated wash is fed to the purifier, where CO_2 and noxious gases are eliminated. A small percentage of aldehydes and other heads fractions passes to the heads concentration column and the now-purified boiling wash is pumped to the feed plate of the analyser column. Direct steam, controlled by the steam regulator, is injected at the base of this column.

The vapours leave the top of the analyser by way of a foam breaker, the main vapour stream passing to the base of the rectifying column where both low and high oils are drawn off, the high oils to a separate tester on the control floor and the low oils to the decanter for separation and disposal.

The remaining heads and other low-boiling vapours pass to the heads concentration column, through the reflux condenser, etc., and finally to separate testers. Hot feints from the rectifier base are pumped either to the analyser or purifier columns depending on circumstances.

The spirit draw-off is on the 42nd plate of the rectifier, the spirit passing through a cooler to the main spirit tester. For an even higher quality spirit, this can be put through a pasteurizer where any final remaining traces of heads are removed by steam.

(ii) *Low-strength rum at* 60 *o.p.*—For this operation, both the purifying column and rectifying column are isolated. The preheated wash is fed to the analyser column and low wine vapours pass direct to the heads concentration column which in this case acts as a rectifying column. Again varying degrees of spirit flavour and strength are obtainable, according to the amount of regulation of the reflux and spirit draw-off systems.

It can readily be seen, if these two combinations of columns, reflux systems, etc., are understood to be at either end of the scale of variations of possible combinations of the main components of this plant, how it is that all these varied products are obtained.

The distillery is designed for a normal production of 150 gallons of 96% (68 o.p.) alcohol per hour which is equivalent to an hourly wash feed rate of 2,200 gallons of wash at 6% alcohol content. This figure was attained with ease and for 12 hours the distillery worked at a maximum input of 3,500 gallons of wash per hour without any trouble from pumps, stills, etc.

Spirit Storage.

From the spirit safe the rum or alcohol, as the case may be, is run to one of three 5 gallon glass-lined tanks. Here the spirit is checked for quality before being pumped to the main storage or warehouse, which consists of seven 5,000 gallon tanks of the same kind. In these tanks the following operations are carried out : (a) Reduction with water to shipping strength (45 o.p.). Instead of the old method of using rain water, the quality and quantity of which was most variable, artesian well-water, purified by aeration, filtration and treatment with ion-exchange resins, is used. The final water is very pure and most suitable for the breaking down of the rum spirit.

(b) Colouring with caramel (burnt sugar) to the required tint, if colouring is required on order. A newly designed plant is used to burn sugar ; with full control of heat, viscosity, etc., a very high grade caramel is produced which gives a most stable rum colouring.

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THE DETERMINATION OF THE APPARENT PURITY OF BEET SUGAR FACTORY JUICES AND SYRUPS

By WM. H. PARKER, M.Sc., Chief Chemist, British Sugar Corporation Ltd.

PART I.

OWING to the almost negligible amounts of invert and sugars other than sucrose normally found in beet sugar factory defecated juices, the process, especially in the sugar end, can be satisfactorily controlled by apparent purity determinations. This, in fact, has become traditionally the general practice in the beet sugar industry. The apparent purity of a juice or syrup, or, simply the "purity" without qualification as it is usually referred to, is the polarization (taken as representing the sucrose content) % of the total solids present. The total solids are usually determined by Brix hydrometer so that the purity is the polarization per 100° Brix, or $\frac{\text{Pol}}{\text{Brix}} \times \frac{100}{1}$.

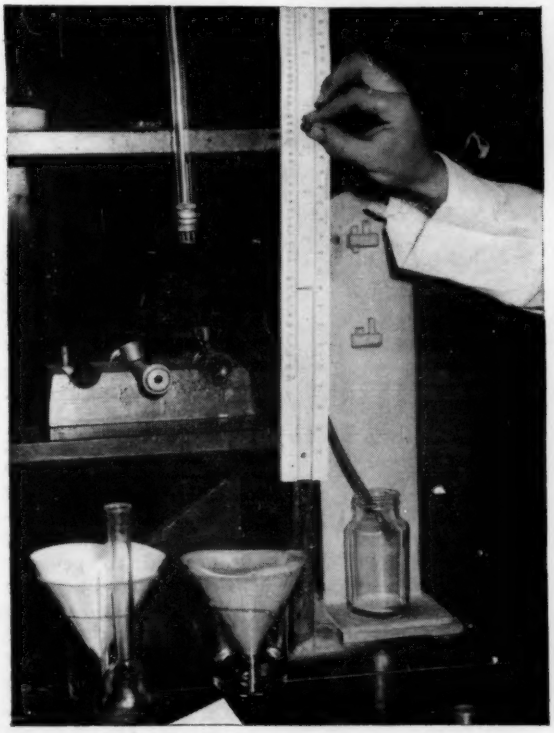

Fig. 1

Measurements are usually taken at 20°C, which is the general standard working temperature in beet sugar factory laboratories. The determination of purity is a somewhat lengthy procedure and the purpose of this article is to describe two aids for speeding up the operation which have been developed by members of the Chemical Control Service staff of the British Sugar Corporation. They are:

(*A*) A purity slide rule for quick calculation of results on thin juices or on syrups diluted to between, say, 12° and 16° Bx.

(*B*) The "Bondanco" purity meter which automatically dilutes a thick juice or heavy syrup to 28° Bx., adjusts the temperature to 20°C, and from a conductivity measurement gives a direct reading of the purity of the sample under test.

(*A*) The Purity Slide Rule.

The general method for determination of apparent purity now employed is known as the one-tenth dilution or, in short, the 100/110 method. This procedure was introduced to eliminate the tedious operation of weighing out exactly a normal 26 gram weight for polarization of juices to be tested. Instead, 100 ml of the juice are measured in a special flask having two separate graduation marks on the neck at 100 ml and 110 ml levels. Sufficient basic lead acetate is added to clarify the solution and the whole then made up to the 110 ml mark with water at 20°C, well shaken, filtered and polarized in a 200 mm tube in a saccharimeter (of normal weight).

The purity is then calculated thus:—

If S = % sugar (polarization of 26 g normal weight) at 20°C,

P = Polarization of the 100/110 solution (direct reading) at 20°C,

B = Brix of the solution at 20°C,

D = Approx. S.G. of the solution at 20°C/20°C,

then $$S = \frac{0{\cdot}26 \times 1{\cdot}1 \times P}{0{\cdot}99718 \times D}$$

and Purity $$= \frac{S}{B} \times \frac{100}{1} = \frac{0{\cdot}26 \times 1{\cdot}1 \times P \times 100}{0{\cdot}99718 \times B \times D}$$

$$= \frac{28{\cdot}6 \times P}{0{\cdot}99718 \times B \times D}$$

Tables of "factors" for that part of the formula $\frac{28{\cdot}6}{0{\cdot}99718 \times B \times D}$ have been constructed for varying Brix values, as well as tables relating polarization and Brix readings to purity, and these are used as "ready reckoners" for obtaining purity results.

Now Purity = Polarization (100/110) × a factor

$\therefore$ log Purity = log Pol + log factor.

Since the Brix for purity determinations by the 100/110 method is normally within the range 12–16° Bx, it is obviously possible to have three scales in the form of a slide rule of practical dimensions graduated for the log purity, log pol and log of the factors to cover this range.

This has been done and slide rules are now in general use for purity determinations on thin juices in all our factory laboratories. The accompanying photographs (Figs. 1, 2) show a slide rule actually being used. In the close-up view the Brix of a high green solution on the sliding scale of 13·5 is set against the direct polarization reading obtained on the 100/110 solution of 37·3 and the arrow gives the corresponding purity of 75·0.

The scales were first set out on millimetre squared paper so that 2 mm = 0·00100. Five-figure log tables must be used to get the desired accuracy in the markings. Finished rules covering the range 12°–16°Bx are about 2 ft long and can easily be read to 0·1% purity. The position of the arrow is fixed by

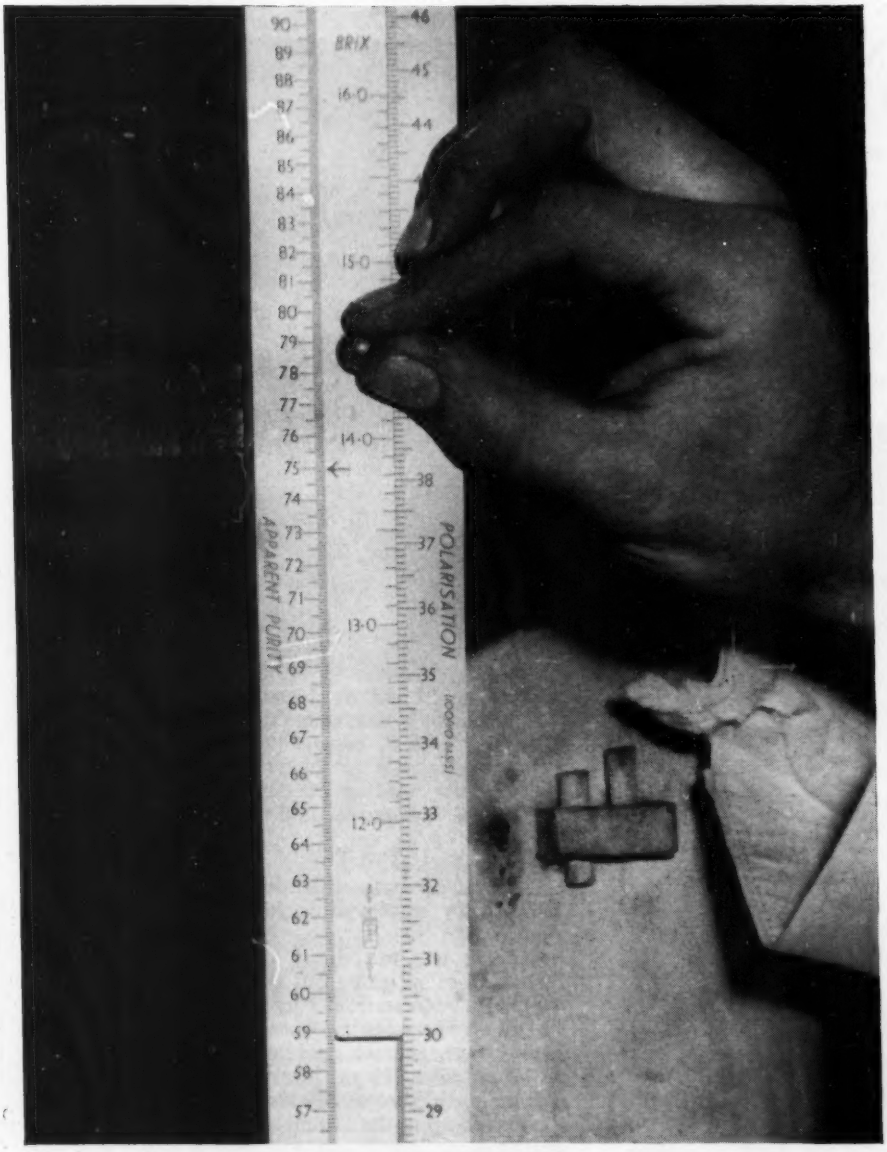

Fig. 2.

reference to a given set of results such as in the example shown in the photographs. The prototype model was made by N. H. BRINTON and O. H. PHIPPS using paper scales pasted on a wooden base. The purity rules in use were made for the Corporation from this model in white plastic material with black and red markings.

(*To be continued*).

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UTILITY OF THE FORMULA FOR CALCULATING EFFICIENCY OF IMBIBITION

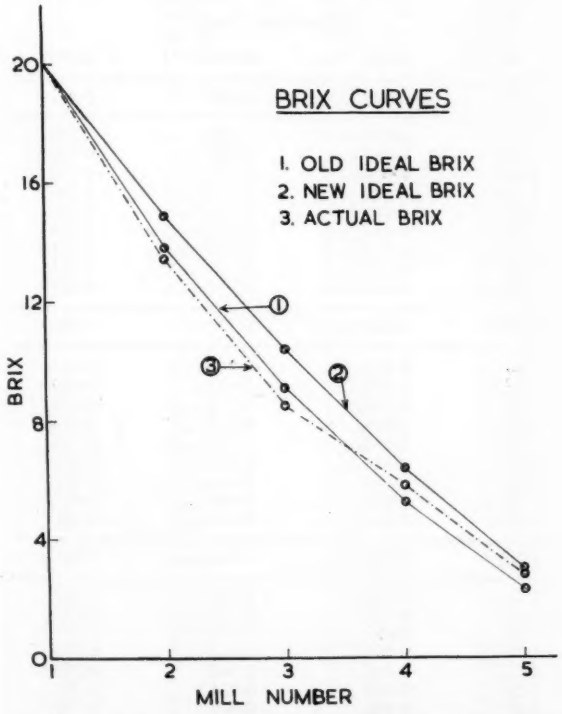
New Calculations for Ideal Brixes of Secondary Juices, Brix-Curves and their Interpretation

By B. L. MITTAL, B.Sc., A.I.I.S.T. (Kodinar, Bombay State, India).

PART II

Brix Curves and Their Interpretation.

The actual Brixes of juices from second, third, fourth and fifth mills, in the above example were 13·5, 8·56, 5·92, and 2·80 respectively. Brix curves are shown in the figure below.



The figure above shows that the two Ideal Brix curves (1 and 3) are not much different in shape but their position relative to that of the actual Brix curve (2) is very much different and this is what matters most in the interpretation of the curves. It would have been inferred from the position of the old Brix curve (1) that the fifth mill is tight, fourth is also tight, third is loose and the second mill is correct. On examination of the relative position of the new Brix curve (3) it would appear that all the mills are loose to varying extents, if it is interpreted in the usual way. In fact this is not the case ; the interpretation of the old ideal Brix curves is as faulty as the old calculations themselves. The Ideal Brix must not be less than the corresponding actual Brix for the simple reason that this is calculated assuming the efficiency of imbibition on all the mills as 100% and this condition is seldom fulfilled in practice. A certain amount of imbibition liquid trickles down in the juice without diluting the residual juice in the bagasse, so diluting the juice expressed by the mill. If the setting of a secondary mill is tight, this will not result in the expression of the native (undiluted) juice from bagasse to an extent that the Brix of the juice will be appreciably altered.

The divergence of the actual from the new ideal Brix curve is due to the combined effect of

(a) the low efficiency of imbibition. The higher the efficiency of imbibition, the closer is the actual Brix curve to the ideal one.

(b) The loose mill setting. If the setting is loose, the expression of juice which is diluted by the imbibition liquid, will be less due to its inherent attachment with the fibre, while the imbibition liquid which adheres only superficially to the fibre will be expressed as usual. Thus the Brix of the juice will be lower than the ideal Brix.

It is important to note that, even if the mill setting is not loose, the divergence will occur if the efficiency of imbibition is not 100%, but the divergence of the two curves will vanish if efficiency of imbibition is 100%, whatever may be the condition of mill setting. Hence the Brix curve alone fails to give any definite information about the condition of mill setting. To obtain the correct information, both the efficiency of

imbibition on each mill and the new ideal Brixes of juices from each mill must be calculated. The method of deriving inferences from them will be well understood from a practical example.

The table II shows the results of calculations from the data of the example cited previously.

TABLE II.

Mill (1)	Imbibition efficiency (2)	Ideal Brix (3)	Actual Brix (4)	Diff. (5)	Diff. % Ideal Brix (6)
II	85·18	14·89	13·50	1·39	9·35
III	48·58	10·41	8·56	1·85	17·77
IV	62·58	6·48	5·92	0·56	8·64
V	61·09	3·03	2·80	0·23	7·92

The values of diff. % Ideal Brix (Column 6) are the combined divergencies due to low efficiency of imbibition and the loose mill setting. Now, in order to find out the divergence due to loose mill setting alone, it is necessary to eliminate the effect of low efficiency of imbibition. It is not possible to find out the absolute values of either of the two. It is therefore supposed to be proper to find out what would be the Brixes of the juices if the efficiency of imbibition were the same for all the mills. The difference of the ideal and the calculated Brixes (at the same level of efficiency of imbibition) will indicate the comparative divergence due to loose mill setting alone. In the above example, 61·09 is taken as the efficiency of imbibition at which the Brixes of juices are calculated for the purpose. Table III shows the results of these calculations. Column (5) of the table gives the comparative divergence due to loose mill setting alone. If the fifth mill setting be taken as normal, then compared to it, the fourth mill setting is slightly loose, the third mill setting is very loose and the second mill setting is also very loose. Again if the mill setting of any other mill be taken as normal, the comparative state of setting of other mills can be easily inferred.

TABLE III.

Mill (1)	Ideal Bx (2)	Bx at 61·09% Imbibition efficiency (3)	Difference (4)	Diff. % Ideal Bx (5)
II	14·89	13·06	1·83	12·29
III	10·41	9·16	1·25	12·01
IV	6·48	5·85	0·63	9·72
V	3·03	2·80	0·23	7·92

Ready Reference Tables

Tables IV and V are prepared and in these tables is given the factor, against different values of c (i.e. $1 + \frac{100 \times W}{m \times b}$), by which the Brix of first mill juice should be multiplied in order to get the ideal Brix of juices expressed by secondary mills of a tandem individually.

Example : In the foregoing example, $c = 2{\cdot}14$,

From table V, factor for second mill juice (first secondary mill) = 0·745.

Factor for third mill juice (second secondary mill) = 0·521.

Factor for fourth mill juice (third secondary mill) = 0·324.

Factor for fifth mill juice (fourth secondary mill) = 0·151.

and since, first mill juice Brix is 20·0,

Ideal Brix of second mill juice = 14·90
Ideal Brix of third mill juice = 10·42
Ideal Brix of fourth mill juice = 6·48
Ideal Brix of fifth mill juice = 3·02

It is hoped that these new Ideal Brix calculations, new interpretation and the ready reference tables will attract the attention of technical personnel of the Sugar Industry.

Acknowledgments

Thanks are due to Mr. P. S. DESAI, the managing director of the Kodinar Khandudyog Khedut Sahakari Mandli Ltd., Kodinar for his kind patronage and encouragement.

TABLE IV.

The factor by which the Brix of Primary juice must be multiplied in order to get Ideal Brix of juice from a secondary unit of a milling tandem consisting of three secondary units.

$$c = 1 + \frac{100 \times W}{m \times b}$$

c	Secondary Units: First	Second	Third
1·50	0·933	0·800	0·533
1·51	0·930	0·794	0·526
1·52	0·927	0·787	0·526
1·53	0·924	0·781	0·510
1·54	0·922	0·775	0·504
1·55	0·918	0·768	0·496
1·56	0·914	0·762	0·488
1·57	0·911	0·755	0·481
1·58	0·907	0·748	0·473
1·59	0·904	0·742	0·467
1·60	0·901	0·735	0·460
1·61	0·897	0·729	0·453
1·62	0·894	0·722	0·446
1·63	0·890	0·716	0·439
1·64	0·889	0·713	0·433
1·65	0·888	0·703	0·426
1·66	0·880	0·698	0·420
1·67	0·876	0·690	0·413
1·68	0·872	0·684	0·407
1·69	0·868	0·678	0·401
1·70	0·865	0·671	0·395
1·71	0·861	0·665	0·389
1·72	0·857	0·659	0·383
1·73	0·854	0·653	0·377
1·74	0·850	0·647	0·372
1·75	0·846	0·640	0·366
1·76	0·842	0·634	0·360
1·77	0·838	0·628	0·355
1·78	0·834	0·622	0·349
1·79	0·830	0·616	0·344
1·80	0·827	0·610	0·339

TABLE IV—*continued.*

c	SECONDARY UNITS First	Second	Third
1·81	0·823	0·604	0·334
1·82	0·819	0·598	0·328
1·83	0·815	0·592	0·323
1·84	0·812	0·587	0·319
1·85	0·807	0·581	0·314
1·86	0·804	0·575	0·309
1·87	0·800	0·570	0·305
1·88	0·795	0·563	0·300
1·89	0·792	0·558	0·295
1·90	0·788	0·553	0·291
1·91	0·784	0·547	0·286
1·92	0·780	0·542	0·282
1·93	0·776	0·536	0·278
1·94	0·773	0·531	0·274
1·95	0·769	0·526	0·270
1·96	0·765	0·520	0·266
1·97	0·761	0·515	0·261
1·98	0·757	0·510	0·258
1·99	0·754	0·505	0·254
2·00	0·750	0·500	0·250
2·01	0·746	0·495	0·246
2·02	0·742	0·490	0·242
2·03	0·739	0·485	0·239
2·04	0·735	0·481	0·236
2·05	0·731	0·475	0·232
2·06	0·728	0·471	0·229
2·07	0·724	0·466	0·225
2·08	0·720	0·461	0·222
2·09	0·716	0·457	0·219
2·10	0·713	0·453	0·216
2·11	0·710	0·448	0·212
2·12	0·706	0·444	0·208
2·13	0·703	0·439	0·206
2·14	0·699	0·435	0·203
2·15	0·696	0·431	0·200
2·16	0·692	0·426	0·197
2·17	0·688	0·422	0·195
2·18	0·685	0·418	0·192
2·19	0·682	0·414	0·189
2·20	0·678	0·410	0·186
2·21	0·675	0·406	0·184
2·22	0·671	0·402	0·181
2·23	0·668	0·398	0·178
2·24	0·665	0·394	0·176
2·25	0·661	0·390	0·173
2·26	0·658	0·387	0·171
2·27	0·655	0·383	0·169
2·28	0·652	0·379	0·166
2·29	0·648	0·376	0·164
2·30	0·645	0·372	0·162
2·31	0·642	0·368	0·159
2.32	0·638	0·365	0·157
2·33	0·635	0·361	0·155
2·34	0·632	0·358	0·153
2·35	0·630	0·354	0·151
2·36	0·626	0·351	0·149
2·37	0·623	0·348	0·147
2·38	0·620	0·344	0·145
2·39	0·617	0·341	0·143
2·40	0·614	0·338	0·141
2·41	0·611	0·335	0·139
2·42	0·608	0·332	0·137
2·43	0·605	0·328	0·135
2·44	0·602	0·325	0·133
2·45	0·599	0·322	0·132
2·46	0·596	0·320	0·130
2·47	0·593	0·316	0·128
2·48	0·590	0·313	0·126
2·49	0·587	0·311	0·125
2·50	0·585	0·308	0·123
2·51	0·582	0·305	0·121
2·52	0·579	0·302	0·120
2·53	0·576	0·299	0·118
2·54	0·574	0·297	0·117
2·55	0·571	0·294	0·115
2·56	0·568	0·291	0·114
2·57	0·565	0·289	0·112
2·58	0·563	0·286	0·111
2·59	0·560	0·283	0·109
2·60	0·558	0·281	0·108
2·61	0·555	0·279	0·107
2·62	0·552	0·276	0·105
2·63	0·550	0·273	0·104
2·64	0·547	0·271	0·103
2·65	0·545	0·269	0·101
2·66	0·542	0·266	0·100
2·67	0·540	0·264	0·099
2·68	0·537	0·262	0·098
2·69	0·534	0·259	0·096
2·70	0·532	0·257	0·095
2·71	0·530	0·255	0·094
2·72	0·527	0·253	0·093
2·73	0·525	0·250	0·092
2·74	0·522	0·248	0·091
2·75	0·521	0·246	0·090
2·76	0·518	0·244	0·088
2·77	0·516	0·242	0·087
2·78	0·514	0·240	0·086
2·79	0·511	0·238	0·085
2·80	0·508	0·236	0·084
2·81	0·507	0·234	0·083
2·82	0·504	0·232	0·082
2·83	0·502	0·230	0·081
2·84	0·500	0·228	0·080
2·85	0·498	0·226	0·079
2·86	0·496	0·224	0·078
2·87	0·493	0·222	0·077
2·88	0·491	0·221	0·077
2·89	0·489	0·219	0·076
2·90	0·487	0·217	0·075
2·91	0·485	0·215	0·074
2·92	0·483	0·213	0·073
2·93	0·481	0·212	0·072
2·94	0·479	0·210	0·071
2·95	0·477	0·208	0·070
2·96	0·474	0·207	0·070
2·97	0·473	0·205	0·069
2·98	0·471	0·203	0·068
2·99	0·469	0·202	0·067
3·00	0·467	0·200	0·067

TABLE V.

The factor by which Brix of primary juice must be multiplied, in order to obtain Ideal Brix of juice from secondary units of a milling tandem consisting of four secondary units.

$$c = 1 + \frac{100 \times W}{m \times b}$$

	SECONDARY UNITS			
c	First	Second	Third	Fourth
1·50	0·968	0·903	0·774	0·516
1·51	0·966	0·898	0·766	0·508
1·52	0·964	0·894	0·759	0·499
1·53	0·961	0·888	0·750	0·491
1·54	0·959	0·883	0·743	0·482
1·55	0·956	0·878	0·734	0·474
1·56	0·954	0·872	0·727	0·466
1·57	0·952	0·867	0·718	0·457
1·58	0·950	0·862	0·710	0·449
1·59	0·946	0·856	0·702	0·442
1·60	0·944	0·850	0·694	0·434
1·61	0·941	0·845	0·686	0·426
1·62	0·938	0·838	0·678	0·418
1·63	0·936	0·833	0·670	0·411
1·64	0·932	0·826	0·662	0·403
1·65	0·930	0·820	0·653	0·396
1·66	0·926	0·815	0·645	0·389
1·67	0·923	0·808	0·637	0·382
1·68	0·920	0·802	0·629	0·374
1·69	0·917	0·796	0·621	0·368
1·70	0·913	0·790	0·613	0·361
1·71	0·910	0·784	0·605	0·354
1·72	0·906	0·777	0·597	0·347
1·73	0·903	0·771	0·589	0·341
1·74	0·900	0·764	0·582	0·334
1·75	0·896	0·758	0·574	0·328
1·76	0·893	0·752	0·566	0·322
1·77	0·889	0·745	0·558	0·315
1·78	0·885	0·739	0·551	0·309
1·79	0·882	0·732	0·543	0·303
1·80	0·878	0·726	0·536	0·298
1·81	0·874	0·719	0·528	0·292
1·82	0·871	0·713	0·521	0·286
1·83	0·868	0·707	0·513	0·281
1·84	0·863	0·700	0·506	0·275
1·85	0·859	0·694	0·499	0·270
1·86	0·855	0·687	0·492	0·264
1·87	0·851	0·681	0·485	0·259
1·88	0·848	0·675	0·478	0·254
1·89	0·844	0·668	0·471	0·249
1·90	0·840	0·662	0·464	0·244
1·91	0·836	0·656	0·457	0·239
1·92	0·832	0·649	0·451	0·235
1·93	0·828	0·643	0·444	0·230
1·94	0·824	0·637	0·437	0·226
1·95	0·820	0·631	0·431	0·221
1·96	0·816	0·624	0·425	0·217
1·97	0·813	0·618	0·418	0·212
1·98	0·808	0·612	0·412	0·208
1·99	0·804	0·606	0·406	0·204
2·00	0·800	0·600	0·400	0·200

c	First	Second	Third	Fourth
2·01	0·796	0·594	0·394	0·196
2·02	0·792	0·588	0·388	0·192
2·03	0·788	0·583	0·383	0·189
2·04	0·784	0·577	0·377	0·185
2·05	0·780	0·571	0·371	0·181
2·06	0·776	0·565	0·365	0·177
2·07	0·772	0·559	0·360	0·174
2·08	0·769	0·554	0·355	0·171
2·09	0·764	0·548	0·349	0·167
2·10	0·760	0·542	0·346	0·164
2·11	0·756	0·537	0·339	0·161
2·12	0·752	0·531	0·334	0·158
2·13	0·748	0·526	0·329	0·154
2·14	0·745	0·521	0·324	0·151
2·15	0·741	0·515	0·319	0·148
2·16	0·737	0·510	0·314	0·145
2·17	0·733	0·505	0·309	0·143
2·18	0·729	0·499	0·305	0·140
2·19	0·725	0·494	0·300	0·137
2·20	0·721	0·489	0·296	0·134
2·21	0·717	0·484	0·291	0·132
2·22	0·714	0·479	0·287	0·129
2·23	0·710	0·474	0·283	0·127
2·24	0·706	0·469	0·278	0·124
2·25	0·703	0·465	0·274	0·122
2·26	0·699	0·460	0·270	0·120
2·27	0·695	0·455	0·266	0·117
2·28	0·691	0·450	0·262	0·115
2·29	0·688	0·446	0·258	0·113
2·30	0·684	0·441	0·254	0·111
2·31	0·681	0·437	0·251	0·109
2·32	0·677	0·432	0·247	0·106
2·33	0·674	0·428	0·243	0·104
2·34	0·670	0·423	0·240	0·102
2·35	0·667	0·419	0·236	0·100
2·36	0·663	0·415	0·233	0·099
2·37	0·659	0·411	0·229	0·097
2·38	0·656	0·407	0·226	0·095
2·39	0·652	0·402	0·222	0·093
2·40	0·649	0·398	0·219	0·092
2·41	0·646	0·395	0·216	0·090
2·42	0·642	0·390	0·213	0·088
2·43	0·639	0·387	0·210	0·086
2·44	0·634	0·382	0·206	0·084
2·45	0·632	0·379	0·204	0·083
2·46	0·629	0·375	0·201	0·082
2·47	0·626	0·371	0·198	0·080
2·48	0·623	0·368	0·195	0·079
2·49	0·619	0·364	0·192	0·077
2·50	0·616	0·360	0·190	0·076
2·51	0·614	0·357	0·187	0·075
2·52	0·610	0·353	0·184	0·073
2·53	0·606	0·350	0·182	0·072
2·54	0·604	0·346	0·179	0·071
2·55	0·600	0·343	0·176	0·069
2·56	0·598	0·340	0·174	0·068
2·57	0·594	0·336	0·172	0·067
2·58	0·591	0·333	0·169	0·066
2·59	0·589	0·330	0·167	0·064
2·60	0·586	0·327	0·165	0·063

TABLE V—*continued.*

c	First	Second	Third	Fourth
		SECONDARY UNITS		
2·61	0·583	0·323	0·162	0·062
2·62	0·580	0·320	0·160	0·061
2·63	0·577	0·317	0·158	0·060
2·64	0·574	0·314	0·156	0·059
2·65	0·571	0·311	0·153	0·058
2·66	0·568	0·308	0·151	0·057
2·67	0·565	0·305	0·149	0·056
2·68	0·563	0·302	0·147	0·055
2·69	0·560	0·299	0·145	0·054
2·70	0·557	0·297	0·143	0·053
2·71	0·555	0·294	0·141	0·052
2·72	0·552	0·291	0·139	0·051
2·73	0·549	0·288	0·138	0·050
2·74	0·547	0·286	0·136	0·050
2·75	0·544	0·283	0·134	0·049
2·76	0·541	0·280	0·132	0·048
2·77	0·539	0·278	0·130	0·047
2·78	0·536	0·275	0·129	0·046
2·79	0·533	0·273	0·127	0·045
2·80	0·531	0·270	0·125	0·045
2·81	0·528	0·268	0·124	0·044
2·82	0·525	0·265	0·122	0·043
2·83	0·523	0·263	0·120	0·043
2·84	0·521	0·260	0·119	0·042
2·85	0·518	0·258	0·117	0·041
2·86	0·516	0·256	0·116	0·040
2·87	0·514	0·253	0·114	0·040
2·88	0·511	0·251	0·113	0·039
2·89	0·509	0·249	0·111	0·038
2·90	0·506	0·247	0·110	0·038
2·91	0·504	0·244	0·109	0·037
2·92	0·502	0·242	0·107	0·037
2·93	0·500	0·240	0·106	0·036
2·94	0·497	0·238	0·104	0·036
2·95	0·495	0·236	0·103	0·035
2·96	0·493	0·234	0·102	0·034
2·97	0·491	0·232	0·101	0·034
2·98	0·488	0·230	0·099	0·033
2·99	0·486	0·228	0·098	0·033
3·00	0·484	0·226	0·097	0·032

Packaging Blocks from Bagasse.[1]—A special type of industrial board is being made by Celotex Ltd.[2] which can be fabricated into packaging blocks to provide accurately predetermined cushioning, bracing and blocking qualities. The board can be cut, drilled, routed, laminated and generally shaped to conform to any irregular contours and replaces expensive moulds.

* * *

Indonesian Factory Difficulties[3].—Construction of the Madukiamo cane sugar factory started in 1954 and it was formally opened on 29th May 1958 but production was postponed several times and huge quantities of cane, kept at the factory for some time, had to be sent to another mill for processing. Charges laid by the East German suppliers were that the Indonesian contractors were unable to lay proper foundations and that these were out of line. Sabotage was alleged. The Indonesian mill manager attributed the trouble to "the unorthodox cooling and lubricating system". Indonesian counter-charges included one that "the plant had been constructed to process beet sugar instead of cane sugar".

BEET SUGAR IN PAKISTAN

By N. D. YUSUF

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A beet industry is to supplement the cane industry for the production of sugar in the country. Advantage is being taken of the ripening periods of the two sugar crops. Experiments show that the sugar beet crop is fit for processing as soon as the sugar cane crop either is finished or the recoveries fall down to the level of uneconomic business. The cane sugar mills already installed in the valley can process sugar beets provided a few pieces of equipment are added to these mills. The estimated cost of such machinery capable of handling 2500 tons of beets daily is about 7 million rupees whereas if new factories exclusively meant for beet processing are installed the cost may be more than double the above estimate. Moreover if beets are processed for 80 days, though 90 days will be the minimum, a total of 200,000 tons of beets will be sliced in a season. Taking the recovery at a most conservative figure of 12% a total of 24,000 tons of sugar will be produced. To grow 200,000 tons of beets about 14,500 to 15,000 acres will be required. Planting of beets by hand needs about 8 lb of seed per acre which is available (including all costs) at Rs. 1/– per lb; thus a total of nearly Rs. 120,000 is to be spent on seed. This recurring expenditure will have to be borne until such time as home-produced seed is developed. It might not take more than another two to three years to finalize the process of home seed production and thus curtail the expenditure on the import of seed into the country. However to import 24,000 tons of sugar, Pakistan is required to spend a sum of no less than Rs. 7,000,000 at the present rate. In other words the machinery imported will repay its cost in the shape of foreign exchange in the first year of its working.

A Mechanization Blue Print for the South African Industry.—In 1955, W. BOA was seconded from the U.K. National Institute of Agricultural Engineering[4]. The Council of the South African Sugar Association has now accepted the recommendations of a sub-committee appointed to formulate on his report a mechanization scheme for the industry. The scheme now approved falls short of that recommended, which was considered too ambitious. It includes the establishment for the North and South Coasts of organizations corresponding to the successful Zululand Field Mechanization Committee, and of a central committee which shall be autonomous, independent of, but working in close association with, the Experiment Station. The composition of the central and regional committees, the technical staff required and the main functions of these are set forth in the South African Sugar Journal.[5]

[1] *Packaging Digest*, 1958, **3**, 152.
[2] North Circular Rd., London, N.W. 10.
[3] *New York Times*, 19th August 1958.
[4] *I.S.J.*, 1955, **57**, 91.
[5] 1958, **42**, 569–571.

SOME ASPECTS OF LOW PRODUCT MASSECUITE TREATMENT

By O. H. PHIPPS

Abridged from the paper presented to the 11th Tech. Conf., British Sugar Corp., 1958.

PART II.

Treatment in the Crystallizer.

As a consequence of the increasing solubility of sugar with increasing temperature and decreasing purity it has been shown that a high Brix massecuite must be boiled if a low purity mother liquor is to be obtained. There is a practical limit to which the Brix can be taken in the pan, and hence a limit to the degree of exhaustion of the syrup, so that the process must be continued by cooling in the crystallizers. That is to say the amount of water present in the pan at the end of boiling must be the practical minimum, and this applies equally at the end of cooling if the lowest possible molasses purity is to be obtained at any given massecuite temperature.

Alternatively one can say that the amount of water present fixes the temperature to which the massecuite must be cooled to give a required molasses purity if one also knows the solubility of sugar at that purity and the degree of supersaturation in the molasses.

An example to illustrate this can be calculated from Grut's table of solubilities for any degree of supersaturation in the molasses, and it is proposed that this should be taken at 1·5 since the indications are that the rate of crystallization is at a maximum at, or near, this point. For a massecuite of 78 purity boiled to a Brix of 95·23° to yield a mother liquor purity of 64, and assuming 1% on massecuite of water in the form of 'steamings out' is added to the crystallizer, the following table includes the information relative to the mother liquor.

Table I.

Mother liquor	Brix	Purity	Temp. °C	Super Sat.	Non Sugar / Water
As dropped	92·42	64	78	1·5	4·39
Plus "Steaming out"	90·98	64	78	1·24	3·63
On Cooling	90·75	63	69	1·5	3·63
,, ...	90·53	62	65·5	1·5	3·63
,, ...	90·31	61	62	1·5	3·63
,, ...	90·08	60	59	1·5	3·63

Massecuite Brix 94·29

This table shows that if equilibrium at 1·5 supersaturation is reached then cooling down to 59°C will give a molasses of 60 purity and 90° Brix. (Grut's tables do not go below 60° purity, but by extrapolation it is estimated that by cooling to 52°C a molasses of 58 purity and 89·6° Brix would be obtained).

In the following table it is assumed that water in successive amounts of 0·5% on massecuite are added to this same massecuite in the crystallizer and that a final molasses purity of 60° is still to be obtained at 1·5 supersaturation.

Table II.

	Mass. Brix	Molasses Brix	Temp. °C	Non Sugar / Water
As dropped	95·23	92·42	78	4·39
Plus steamings 1% on mass.	94·29	90·98	78	3·63
Added Water 0·5% ,,	93·82	89·31	54	3·34
,, ,, 1·0% ,,	93·36	88·55	49	3·10
,, ,, 1·5% ,,	92·91	87·81	44	2·88
,, ,, 2·0% ,,	92·46	87·08	40	2·70
,, ,, 2·5% ,,	92·01	86·36	36	2·53

Thus if the massecuite Brix is reduced by the addition of water to 92° then the massecuite must be cooled down to 36° to obtain a molasses purity of 60. In both the above tables it will be noted, of course, that the massecuite Brix corresponds to a purity of 78. If the massecuite purity is higher or lower then the Brix will be correspondingly higher or lower. On these grounds alone, therefore, it appears better to boil massecuite of the lowest possible purity, for then not only will the Brix be correspondingly lower, but also the crystal content for any given mother liquor purity and consequently the resistance to stirring in the crystallizer. Lower purity final massecuite must also mean that more sugar has been extracted in the higher purity boilings and so less final massecuite will be boiled, but the boiling time must be longer because of the lower purity, which cannot be compensated for by increasing the degree of supersaturation. This then is one further instance of the complexity of the problem the practical man has to face.

The molasses Brix given in the above tables are of course independent of the purity of the massecuite and depend only on the degree of supersaturation and the temperature, as does also the ratio of non-sugar to water.

Having now shown how the quantity of water present fixes the temperature of cooling for any final purity it remains to decide which procedure is the one to be adopted as the best practical proposition. This decision will in practice be dependent upon the crystallizer construction and available capacity relative to the factory throughout, which will in turn fix the temperature to which the massecuite can be cooled and the length of time in the crystallizer ; but probably the over-riding consideration is the viscosity of the massecuite.

To take temperature and time first, it has been shown previously that rate of crystallization is higher the higher the temperature and so where cooling time is limited then theoretically the initial cooling should not be too rapid in order that the average temperature over the whole cooling period should be as high as

possible. On practical grounds however, the initial cooling rate will be determined on the one hand by the quantity of 'steamings-out' and on the other, to prevent sugar destruction. For instance, in the example already quoted 'steamings-out' of 1% on massecuite have been assumed, which at 78°C would give a supersaturation of 1·24 rising to 1·5 at 72°C ; but if the steamings had been excessive at 2·4% on massecuite (i.e. about 170 gallons of water for a 33-ton strike) then the syrup would be only saturated at 78°C and the supersaturation would not reach 1·5 until about 60°C was reached.

The phenomenon of foaming in crystallizers, indicative of sugar destruction, is not unknown to sugar technicians and the first line of control is to cool the masse as rapidly as possible, and only if this fails is alkali added. In both cases an artificially low purity, or more molasses, may be obtained. Whether or not foaming is seen to occur it does therefore seem politic for the initial cooling to be as rapid as possible, with the proviso that the period of rapid cooling should not be unduly extended for the reason given above. In fact where cooling time is limited it does not appear advisable to aim at too low a final temperature, even if that could be obtained in the time available; for if, for example, the massecuite of 92° Brix cooled down to 36°C to give a molasses of 86·36° Brix and 60° purity at 1·5 supersaturation had instead been cooled down only to 50°C, then for the same molasses obtained the degree of supersaturation would be 1·24, but at this supersaturation and temperature the rate of crystallization, according to the graph, is still greater than at 1·5 and 36°C respectively. Therefore it is not quite improbable that the two procedures could yield the same result and if so, then the advantage lies with higher temperature method because of the much reduced viscosity of the molasses. In fact, practical experience seems to confirm that time, temperature and degree of supersaturation are to a large extent self-compensatory factors which operate to our advantage so long as we do not strain their tolerance too far.

Turning now to viscosity effects, the first thing to be said is that the water content of the massecuite can only be limited in consideration of the strain that can be placed upon the mechanical gear of the crystallizer.

Reference has already been made to the reduction in crystal content by boiling lower purity massecuites, thereby allowing a higher Brix mother liquor to be carried and this must be a matter for individual factories to decide whether it is of overall practical advantage.

Secondly, about viscosity itself in relation to sugar solution, it can be said that :—

(1) Just as the solubility of sugar in syrup of low purity is an inexact figure, varying with the type of non-sugar present, so is viscosity not determined solely by purity and Brix.

(2) Pure sugar solutions are more viscous than an impure syrup of the same dry substance content and at the same temperature. This difference in viscosity is all the greater the lower the purity and the higher the dry substance.

(3) Viscosity decreases with increasing temperature by about 10 to 12% for every °C rise.

(4) Viscosity increases with increasing dry substance. There is no regular increase with increasing Brix but, in the vicinity of 86° Brix and 40°C, viscosity almost doubles for an increase of 1° Brix.

By reason of item (1) above it is impossible to quote figures for viscosity applicable to different factories' molasses. However in table III comparative viscosities for the molasses Brix in tables I and II are given at the temperature to which the massecuite is cooled. In the succeeding columns the effect on the viscosity of falls of 10% and 20% in the temperature of the massecuite during centrifuging have been shown. (The viscosities have been calculated from the original viscosities by allowing an increase of 12% for every degree fall in temperature).

TABLE III.

Molasses Brix	Temp. °C	Viscosity poises	Temp. °C	Viscosity poises	Temp. °C	Viscosity poises
90·08	59	420	53	830	47	1600
89·31	54	550	49	970	44	1700
88·55	49	650	44	1140	40	1800
87·81	44	800	40	1250	36	2000
87·08	40	800	36	1250	32	2000
86·36	36	900	33	1260	30	1760

It cannot be emphasized too strongly that these figures are of no general application and are given merely as indication of what might happen. No valid conclusions can thus be drawn, and in fact, these figures do not permit of any conclusion as to the superiority of one method of treatment over another. One would probably prefer to cool lower than the 59°C, for a variety of reasons, but the essential question remains—is there any advantage in cooling to comparatively low temperatures ?

No firm answer to the question can be deduced on theoretical grounds, but to those who advocate low temperatures and object to the above figures on the grounds that they are calculated for the same final purity of 60° it can be said that if the viscosity of 900 poises at 36°C is tolerable in the crystallizer, then for equivalent viscosity at 49°C the Brix could be allowed to rise from 88·55 to 89. Consequently, if the supersaturation remained constant at 1·5, there must be less sugar in solution and so the purity would then be lower than 60°.

The quantity of water to be added to the crystallizer is arrived at by making use of the non-sugar : water ratios given in table II and the actual non-sugar : water ratio of the massecuite after all 'steaming-out' have been thoroughly mixed in. Thus, for example, taking the non-sugar/water ratio of the massecuite at 3·63 and if this is to be cooled to 44°C then the desired non-sugar/water ratio is 2·88, and so :—

$$\text{Water required} = (100 - 94{\cdot}29)\,\frac{(3{\cdot}63 - 2{\cdot}88)}{2{\cdot}88}$$

$$= 1{\cdot}49\% \text{ on massecuite.}$$

For a 33-ton massecuite 0·49 tons of water are required, or 110 gallons.

As stated earlier some of this water could have been added in the vacuum pan before striking ; in fact the whole of this quantity would not have reduced the supersaturation to 1·0 in this particular case. If this procedure is adopted in practice then the quantity of water that can safely be added can be deduced from the Brix of the massecuite and purity of mother liquor with the aid of GRUT's tables.

If water is added in the crystallizer only then it is probably better to add the major portion (say three quarters) quite early in the cooling period when the degree of supersaturation is not so critical for rate of crystallization as it is at lower temperatures.

Finally, regarding dilution it is interesting to note that GRUT[1] from a series of crystallization experiments deduced that a non-sugar/water ratio of 2·9 and cooling to 40°C gave the best molasses exhaustion. Other writers also advocate a figure of about 3, but it must be remembered that this figure is dependent upon the solubility of sugar, which in turn is dependent upon the nature of the non-sugars present.

CENTRIFUGING.

So far the dilution of the massecuite has been considered only in relation to mother syrup purity aimed at, the temperature of cooling and the viscosity as it concerns the mechanical tolerance of the crystallizer gear, but the final decisive factor will be ability to purge the resulting massecuite in the centrifugal. This will depend upon (a) the viscosity of the massecuite, which involves Brix and temperature, (b) the crystal size and (c) the gravity factor of the centrifugals, in that order of importance.

With regard to the viscosity of the massecuite this can be adjusted to suit the centrifugals either by further dilution in the crystallizer or by reheating. In both cases one must know the limiting viscosity figure. For the Tirlemont refinery J. STORMS[2] quotes a maximum permissible figure of 70 poises for centrifugals with a gravity factor of 1500. This corresponds to a Brix of between 84° and 85° at 45°C, whereas in the British Sugar Corporation factories we appear to be able to obtain molasses of up to 88° Brix at this temperature. It is as well to note in this connexion, however, that Brix is a variable figure according to the method of determination, which should be stated for any comparison.

As a compromise a maximum viscosity of 80 poises is taken and the corresponding Brix of molasses at the temperatures, given earlier in Table III, are shown in the Table IV below.

TABLE IV.

Temp.	°Brix	Degree of supersat.	Viscosity (poises)
54	86·4	1·14	80
49	85·3	1·12	80
44	84·4	1·13	80
40	83·8	1·16	80
36	82·8	1·15	80

This table discloses the fact that for equal viscosity at different temperatures the degree of supersaturation also remains constant.

In Table V are shown the temperatures to which the original molasses of Table III must be reheated to give a viscosity of 80 poises and supersaturation of 1·14.

TABLE V.

Molasses Bx.	Cooled Temp. °C	Reheated Temp. °C
90·08	59	72
89·31	54	69
88·55	49	66
87·81	44	62
87·08	40	58
86·36	36	54

As reheating of massecuite is a specialised subject on its own its mechanics will not be discussed here, except to say that it is a lengthy process because of the very small heat transfer coefficient. Its advantage lies in the fact that danger of excessive dilution of the massecuite is eliminated. However the writer has seen no evidence to establish that a massecuite cooled and reheated yields a molasses of lower purity than the same massecuite kept for an equivalent total time in the crystallizer at a higher temperature and lower degree of supersaturation.

Crystal size plays an important part in the case of centrifuging the massecuite. For obvious reasons the grain should be even in size and, purely from the centrifuging view point, as large as possible. However as the rate of crystallization is dependant upon the total surface area of crystal in the massecuite a compromise has to be made and various writers suggest between 0·25 mm to 0·3 mm as the ideal crystal length.

Finally, as to the gravity factors of the centrifugals, be this what it may, it will for certain be unable to correct for a completely unsatisfactory massecuite condition. The higher it is then the higher can be the Brix of the massecuite dealt with at the expense of centrifuging time, but possibly lower purity molasses. Therefore when considering the replacement of low speed machines with those of high gravity factor we must decide (a) whether low purity and low output or (b) the same purity and high output is what we desire from the new centrifugals. Or again the eternal compromise which is inseparable from this whole subject of low product massecuite treatment!

Tongaat Sugar Co. Ltd. 1957/58 Report.—A record output of 115,813 tons of sugar was produced during the 1957/58 season, from 989,542 tons of cane, at an average crushing rate of 200·4 t.c.h. Capital expenditure rose to £445,490 including £66,884 on buildings, £122,560 on machinery and plant, £83,983 on irrigation, and £94,241 on motor vehicles, tractors, trailers and field cranes. A 24,000 sq. ft. h.s. quadruple effect evaporator was bought as well as 5 high-speed centrifugals. The expenditure on motor vehicles, trailers, etc. was necessitated by conversion of locomotive transport to road haulage, but this has produced a direct saving during the year of £47,000 compared with using tramline-cum-South African Railways haulage. The final dividend brings the total to 23% on the ordinary shares.

[1] *Zucker*, 1953, **65**, 411–416 ; *I.S.J.*, 1954, **56**, 19.
[2] *Sucr. Belge*, 1954, (21).

Cane Preparation. M. C. FREDERICK. *Jamaican Assoc. Sugar Tech. J.*, 1956, **19**, 44–50.—Recent literature on cane payment is reviewed. The types of cane unloader are discussed and a new design proposed which has horizontal hydraulic rams attached to the tipping platform. Cane carriers, knife sets and knife drives and their operations are discussed. It is concluded that the main feature of plant prior to the knives is to supply a constant and even mat. For maximum knife capacity the mat should cause the h.p. used by the knife to approach the maximum value, although not dangerously near, and to remain at this figure for maximum time. Two knife sets, each with its own carrier, should be used, preceded by a form of kickers. The knives should be short and of a type dependant on the type of cane being ground. The knife drive should be either electric motor, steam turbine or reciprocating steam engine depending on existing conditions. The advisability of using two sets of cane knives was queried in the discussion following the paper as this had caused a drop in crushing rate as a result of "over-preparation".

* * *

Hydraulic Relieving Gear for Cane Mills. H. C. NURSE. *Jamaican Assoc. Sugar Tech. J.*, 1956, **19**, 50–55.—The function and design of mill hydraulics are briefly discussed and a description given of the author's top roller lift indicator installed at New Yarmouth. This is basically a thrust rod which moves up and down inside a pipe. The top of the pipe is slotted and the indicator arm lies inside this slot and is pivoted about a fixed point outside the pipe. The rod moving upwards lifts the indicator arm, by way of a steel ball, and the motion is thus amplified at the free end of the arm which moves in an arc against a calibrated scale.

* * *

Microbiology in Mill Sanitation Control. P. D. SMITH. *Jamaican Sugar Tech. J.*, 1956, **19**, 58–66.—The literature on mill juice contamination is reviewed and an account given of investigations made at Monymusk. Bacterial counts show that the number of micro-organisms entering with the cane varies considerably and that cane should be sent to the mill as soon after cutting as possible. Use of "E.C." (sodium hypochlorite containing about 1% of available chlorine) at a rate of 0·5 p.p.m. on juice does not eliminate any appreciable number of micro-organisms but may retard multiplication. Heating to 140°F would produce "commercial sterility" and periodical washing with hot water under pressure is advocated for the removal of bagasse, debris and slimes from the mills, carrier chains, etc. Routine microbial counts are considered a helpful guide to sanitary conditions in the mills, in spite of the delay of 48 hours between sampling and obtaining the information.

* * *

The Thompson-Eisner Furnace at Worthy Park. O. M. CLARKE. *Jamaican Assoc. Sugar Tech. J.*, 1956, **19**, 67–69.—Difficulties in operation of a Thompson-Eisner furnace were attributed to the insufficient height of the check wall and to the chute design which caused bagasse feed to change direction on entering the furnace, with consequent chokes. The angle of repose of the bagasse is 45° whereas the furnace is designed for an angle of 50°; consequently the bagasse is within 18 inches of the top of the check wall and it is difficult to prevent excessive carry-over of bagasse. A second furnace installed with modifications to avoid these effects has operated well, and it is planned to modify the first to improve its performance. The advantages of the Thompson-Eisner furnace are discussed.

* * *

Factory Operation in Hawaii. ANON. *Rpt. H.S.P.A. Expt. Sta. Comm.*, 1957, 26–30.—A series of 18 tests conducted by 11 factories has shown that lower quality sugar is obtained when low grade sugar is used for seeding commercial sugar strikes than when shock or slurry seed is used. Addition of phosphate in economical amounts to mixed juice had no appreciable effect on colour or filtrability of commercial sugars. Instruments have been installed on a milling tandem at Oahu to record cane blanket thickness, knife and shredder power requirements, carrier speed and top-roll mill movement. Data from these will be used to design a feed control system for a study of mill performance. New weak-base anion membranes in demineralization tests did not suffer, as did the strong-base membranes, from the permanent fouling reported previously[1] and associated with electrical resistance build-up, but they are unsatisfactory because of a higher initial resistance and are very sensitive to pH changes with rapid build-up in resistance. A recent evaluation shows that the process is economical only if the average membrane life is one year, which is so only in the case of the cation membranes. "ET-81" polyelectrolyte is now in routine use for improving settling rates and clarity in many factories. Although effective in the treatment of juice from cane grown in grey hydromorphic and alluvial soils, which cause most clarification trouble, it is inadequate for juices from high rainfall areas (most of Hawaii). In test runs on a Dorr-Oliver "Mercone" continuous centrifugal at Waialua sugar of 96–97° pol was obtainable from massecuites of

[1] *I.S.J.*, 1957, **59**, 250.

up to 92°Bx (refractometric) without washing, at a rate of 4 tons/hr, and a sugar of 98·3 pol was obtainable with washing. To eliminate a large quantity of sticky lumps of powdered sugar from the cured sugar, the number of flights on the helix installed to scrape the sugar for discharge was reduced and a variable-speed drive installed on the helix. It was found that the grain was still crushed and that this was primarily due to impact on discharge. Modifications to overcome this are planned. The advantages of the machine are low power requirements and investment costs. No significant differences were found in the yield figures or quality of cane harvested with the cutter-windrower and with the push-rake. The pol ratio method of cane weight determination gives results little removed from those obtained from the routine factory control method and is recommended for those occasions where factory control is not applicable.

* * *

Unknown Losses. A. SINGH. *Indian Sugar*, 1957, **7**, 519–521.—Unknown losses at the author's factory were examined and found to be largely due to the use of pol balance rather than the sucrose balance. Other possible causes mentioned are alteration of the glucose : fructose ratio and hydrolysis of amino-acid amides.

* * *

Optimal Conditions for Yellow Sugar Affination. YU. D. KOT. *Sakhar. Prom.*, 1958 (1), 18–25.—Results of laboratory tests on mixtures of yellow sugar (95·6 purity) and green syrup (75 purity) (6 : 4 by weight) show that the best affined product (colour and purity) is obtainable when a high density syrup is used and the initial temperature is high, but that affination at high temperatures with a syrup diluted to lower Brix (74–70°) will give poorer results than at lower temperatures. Affination at 35°C gave a yield of 99·8% with a purity of 95·92, while at 89°C the yield was 94·5% at 97·20 purity. The best results were obtained when the green syrup was diluted to 72° Brix at 50°C, giving 98·22 purity sugar in 92·4% yield. Five minutes' mixing time was the optimum. The quality of the affined product improved with increased amounts of green syrup, the purity being 98·2 with 30 g of green syrup per 100 parts massecuite and 98·8 with 70 g.

* * *

Rational Operating conditions of a Centrifugal Electric Motor with Centrifugal Clutch. K. A. BORTNOVSKII. *Sakhar. Prom.*, 1958, (1), 25–31.—A practical method of determining the optimal weight and dimensions of centrifugal clutch blocks is described. Wooden blocks were specially made, hollowed out on the inside to take a number of metal plates weighing 100 g each. Thus the weight of the blocks could be varied from 0·7 to 1·4 kg, and the variation in weight of the moving parts of the clutch from 1·4 to 5·6 kg using 1 to 4 blocks to alter the working conditions of the motor. The mode of determining the required data is illustrated by tabulated results and graphs.

Results of tests with a High-speed PN-1000 Centrifugal. B. N. TERESHIN and A. P. PONOMARENKO. *Sakhar. Prom.*, 1958, (1), 33–35.—Tests with the Soviet PN-1000 centrifugal are described. The 4-speed machine (100, 250, 750, and 1500 r.p.m.) has a stainless steel basket 1000 mm in dia. and 750 mm deep with a capacity of 450 kg. The electrical braking is automatic to 750 r.p.m., mechanical braking being necessary below 750 r.p.m. An automatic timing device is used for starting and braking. The optimal length of cycle is 12–14 min, including 40–60 sec for unloading with the mechanical plough, according to sugar quality.

* * *

Testing the SA-1 Automatic Saccharimeter designed by Kudryavtsev. I. M. LITVAK and M. N. BARABANOV. *Sakhar. Prom.*, 1958, (1), 44.—The saccharimeter, previously described[1], was tested with standard sucrose solutions and with coloured solutions of known sugar content. The difference between the results of sucrose determined with the saccharimeter and by refractometer was less than 0·1%. Each standard sucrose solution was tested 5 times. The instrument is recommended for general factory use, despite its disadvantage of heating the polarimeter tube casing to 38–40°C after 1–2 hr.

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From our Experience (Lime Kiln Feed Indicator). A. P. MACLENNIKOV. *Sakhar. Prom.*, 1958, (1), 61–62.—A lime-kiln feed indicator consists of a car headlamp mounted on one side of the kiln 2·3 m above the feed door. When the level has fallen this shines through a window on the other side of the kiln and onto a blackened screen.

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A new Foam Breaker for Raw Juice Measuring Tanks. N. I. POCHINOK. *Sakhar. Prom.*, 1958, (1), 63.—Unfiltered first carbonatation juice enters by way of a central feed coupled to the centre of a rotating 750 mm pipe at the end of which are two atomizers, one pointing upwards and the other down. When the foam level rises in the tank, the feed valve is opened and the juice is sprayed on to the foam.

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Vapour Condensation in the Sugar Industry. L. NESVADBA. *Zeitsch. Zuckerind.*, 1958, **83**, 18–22.—Vapour condensation in the sugar factory is reviewed and equations developed for the determination of the quantity of injection water and air, and of the pressure and temperature of gas for the air pumps. The size of the condenser, condenser water tube and tank are also discussed in addition to the auxiliary equipment. Air-cooled surface condensation is suggested where there is need for water economy. The air is dampened to 100% R.H. before passing through the ribbed pipe cooling elements. Its heat exchange coefficient rises and the temperature of the incoming air is somewhat reduced. The equipment costs more than water-cooled condensation equipment because of the greater heat exchange surfaces, but the operating costs are much lower.

[1] *I.S.J.*, 1958, **60**, 112.

A Review of Present Day Treatment of Low Grade Massecuites. F. M. CHAPMAN. *Paper presented to the 11th Tech. Conf., British Sugar Corp.*, 1958.—The characteristics of a satisfactory low-grade massecuite are considered, at Tate & Lyle refineries, to be: 40–44% of crystals; average crystal length 0·3 mm, with little spread; 89 refractometric dry solids in mother syrup; and a temperature only 2–3°C above the final massecuite temperature (reheated with water). The effects of crystal population and molasses purity are briefly discussed, and the results recorded of investigation into sucrose loss in crystallizers during slow and fast cooling and reheating. Sugar is not found to redissolve if the reheating water is at the right temperature, and the equipment used is described and illustrated. The passage of air through a centrifugal, which decreases its efficiency, may be reduced by fitting covers, sealing the outlet pipes by submerging in molasses, and by blowing a little low-pressure steam into the monitor casings. Mother syrup analyses indicate that more than 2% of crystals entering the basket may be lost by overcharging or passing through the screen.

* * *

First Product Massecuite Boiling from Higher Density Syrup. A. P. PONOMARENKO. *Sakhar. Prom.*, 1958, (2), 20–22.—The installation at the Stalin factory for boiling syrup of higher density than normal (up to 75°Bx) comprises a concentrator and thickener in series with a triple-effect evaporator. The concentrator and thickener are heated by steam from the 3rd effect and the vacuum pans by steam from the 2nd effect. Juice density is 12·3°Bx and draught is 148% on beet. The resultant steam economy is 1·03% by weight on beet or 1·9% by weight of steam where 55% by weight on beet is the normal steam consumption. Test boilings have yielded massecuites of 92·1–93·5°Bx.

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Exhaustion of Final Molasses with Increase in its Concentration. I. N. KAGANOV and L. S. TVERDOKHLEBOV. *Sakhar. Prom.*, 1958, (2) 22–25.—Laboratory experiments were carried out on crystallizing sugar at 40°C from final molasses of concentrations from 84 to 92% dry solids and 62·8 purity, to which was added sugar of crystal size 0·5–1 mm at the rate of 60 g sugar to 150 g molasses. Results are expressed in graph form and show that the purity of the molasses decreases with increased dry solids concentration, but only to a definite limit, after which the purity would rise again. The maximum exhaustion independent of crystallization rate (4–9 days in the tests) is from molasses of 86·6–87·1% dry solids.

* * *

Optimal Scheme for Yellow Sugar Affination. B. Z. ZAK. *Sakhar. Prom.*, 1958, (2), 29–31.—The scheme described has been used for a number of years when processing sub-standard beets and is as follows: yellow sugar of 93–94·5 purity from 2nd product massecuite is mingled with green syrup of 82–84% dry solids and 77–78·5 purity from 3rd product massecuite, heated to 88–95°C, to give an affination masse of 87–90°Bx (refractometric). The affined product is centrifuged without washing. The affination syrup of 70–71 purity is used for the last drinks in 2nd massecuite boiling to lower the purity of the mother-liquor to give a sugar of 95·5–96 purity. The colour of the sugar has been decreased by 38–60% and its purity increased by 0·8–1·6 units.

* * *

Bagging Granulated Sugar in Multi-walled Valve Sacks. M. B. YARMOLINSKII. *Sakhar. Prom.*, 1958, (2), 34.—Factory trials at the Stalin sugar factory with a "Vollenda" automatic bagging machine have proved satisfactory. The machine (of West German manufacture) requires only one operator and can weigh, fill, close and count 1000 multi-walled kraft paper sacks in 8 hr (i.e. 40–50 tons of sugar). A similar machine has been installed at Zherdevsk sugar factory.

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Choice of Condensate Scheme and Condensate Removers. A. E. KUTSENKO. *Sakhar. Prom.*, 1958, (2), 36–40. The efficiencies of evaporator condensate control plant using the Chugunov system of hydrodynamic columns, the Central Research Institute's water removers and Niessner's columns are compared. The disadvantages of the Chugunov and Central Institute's systems include difficulties in circulation with poor vapour separation and flash evaporation and frequent condensate entrainment through the vapour discharge. The Niessner system is considered the most efficient of those studied and is being used in many Czechoslovakian factories. Some modifications in design of the hydraulic column are suggested with diagrams.

* * *

Improve Sugar Quality by using Superheated Water in Centrifugal. H. W. K. CHEIN. *Taiwan Sugar*, 1958, **5**, (1), 32–35.—Experimental washing with superheated water at 107·5°C showed: that the amount of water was reduced by 28–35% compared with cold water washing; that the difference in moisture content of the washed sugar was 0·006–007%; that the ash content was reduced by 0·009–0·10%; and that the sugar was more uniform (the quantity of 10–20 mesh grain was 0·79–7·69% more). Further advantages are the use of less steam for sugar drying and boiling as a result of reduced re-boiling of molasses.

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Investigations of the Prototype Szarejko Filter-Press with Hydraulic Mud Removal. S. ZAGRODZKI and Z. NIEDZIELSKI. *Gaz. Cukr.*, 1958, **60**, 35–42.—Tests of the Szarejko filter-press[1] are reported. Good results were achieved with a filter area of 188 sq. m. and a flow rate of 7 litre/sq.m./min; a drop in the flow rate towards the end of filtration was prevented by applying supplementary pressure. Sweetening-off was effected with a hot water spray at 8 atm. Average juice alkalinity was 1·65 g CaO/100 ml and the average mud thickness was 29 mm, the best being 52 mm.

[1] See *I.S.J.*, 1958, **60**, 144, 210.

The average sugar content of the mud was 1·4%, ranging from 0·8% to 4·1%. "Steelon" (nylon) filter cloths were satisfactory, even for such mud thicknesses as 52 mm and the average cycle length was 174 min. A period of 165 min for the complete cycle is suggested, including 100 min for actual filtration.

* * *

Apparatus for Counting Sugar Bags. ANON. *Gaz. Cukr.*, 1958, **60**, 51.—The device at Opalenica sugar factory for counting 50- or 100-kg bags, which is illustrated, comprises a counterbalanced lever at one end of which is an idler over which the conveyor belt passes. The bag depresses the lever, which is attached at the other end to a hydraulic ram. Movement of the ram operates one of two counters, which one depending on the length of traverse.

* * *

Sugar Rendement and Affined Sugar Yield. A. MIRCEV and K. SANDERA. *Listy Cukr.*, 1958, **74**, 35–38.—Sugar rendement is a function of sugar purity, syrup and crystal properties, temperature, and time and rate of spinning. In a study of rendement three 5-ton samples of raw sugar of 92·8, 95, and 97 rendement values were affined and the yields, colour and ash of the refined product compared. The highest yield was obtained from the 95 rendement sugar, but the difference between the three yields and between the properties of the three products was very slight. From the results it is concluded that it is uneconomical to affine sugars of a rendement value greater than the optimum of 94–95, as with higher values there is marked dissolving of the sugar.

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Problems of Packaging Granulated Sugar for Transport. J. PRIBYL. *Listy Cukr.*, 1958, **74**, 39–44.—An illustrated review is given of the methods and various types of machinery used to stitch jute and paper sacks.

* * *

Limestone Dust as a Defecation Aid. R. CAROLAN and C. O'DONOVAN. *Irish Sugar Co. Ltd. Res. Lab. Rpt.*, 1958, (39), 12 pp.—In laboratory tests it was found that replacement of some of the defecation lime with ground limestone dust did not impair filtration or increase the salts, but juice colour was greater. Addition of limestone before or after 2nd carbonatation decreased the lime salts since it acted as nuclei for deposition from the solution which was supersaturated with respect to $CaCO_3$. Thus, limestone added to oversaturated juice will neutralize the bad effect of oversaturation, but will not reduce the high colour. Limestone should therefore be used to replace some of the soda addition; it reduces the amount of molasses formed and is much cheaper, although more 2nd carbonatation press-cake will be formed. In addition, the danger of carbonate scale formation caused by excessive soda addition is reduced.

Possibilities and Errors in Carbon Monoxide Determination. A. NARJES. *Zucker*, 1958, **11**, 114.—Various methods of determining CO in kiln and furnace waste gases are described. The use of the Orsat gas analyser, in which the CO is absorbed in a Cu_2Cl_2 solution, is discussed. The use of only one pipette is unsuitable for high CO content, at least two being needed as the CO is not firmly bound by the Cu_2Cl_2–solution but forms only an easily decomposed adsorption compound; this may lead to considerable error after prolonged use of the solution. A method of determining when a Cu_2Cl_2 solution must be changed is described. The advantages and disadvantages of other absorption solutions are discussed. A method especially suitable for determining greater amounts of CO is described, in which the CO is burnt on a glowing platinum wire sealed in an additional combustion pipette in an Orsat analyzer. The wire is heated by a standard resistance transformer. The CO_2 and O_2 are determined by absorption and the remaining gas ($CO + N_2$) diluted with appropriate amounts of air and the gas-air mixture passed several times over the platinum wire. The CO may be determined from the resultant volume contraction, or by absorbing the CO_2 produced in KOH. The various types of apparatus for continuous measurement or control of CO are also described and the individual measuring principles explained and examples quoted.

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General Outline of the Rational Construction Principles of Sugar Centrifugals and their Dischargers. E. KRIEG. *Sucr. Belge*, 1958, **77**, 233–238.—The rotatory speed of the centrifugal basket during discharge is discussed with the aid of diagrams; the optimal speed, at which the sugar will fall vertically through the discharge port, is given as <50 r.p.m., preferably 25 r.p.m. For a discharge plate 130 mm wide, 5 revolutions of the basket are not sufficient to scrape a height of 610 mm of sugar, as the guides will not travel 130 mm. Such a plough will scrape 30–70 mm sugar per revolution, depending on wear and tear. Suggestions are made concerning the construction of centrifugals with manual dischargers.

* * *

Crystallization Rate of Sucrose in Green Molasses at 70°, 80° and 90° (C). P. V. GOLOVIN, A. A. GERASIMENKO and M. A. ABRAMOVA. *Sakhar. Prom.*, 1958, (3), 10–12.—The rate of crystallization of sucrose from green molasses, the apparent and true supersaturation coefficients and the saturation coefficients were determined at 70°, 80°, and 90°C, using molasses of 81·3% to 87·6% dry solids and 64·46% to 69·45% sugar content. For a given supersaturation coefficient and a constant purity of the solution it was found that the crystallization rate increases only up to 80°C, after which it decreases; this temperature can, therefore, be accepted as the optimum for 2nd product massecuite boiling.

BEET FACTORY NOTES

Rational and Automatic Mechanical Devices. D. V. KARPUKHIN. *Sakhar. Prom.*, 1958, (1), 54–60.—The devices, which have been installed in factories in the Kirghiz Republic, are described and illustrated and include : a pulsating pulp-trap in which the pulp is removed from the outside screen by rubber-edged scrapers mounted on an interior revolving screen ; automatic level control (electrical and pneumatic) for diffusion juice measuring tanks and for defecation milk-of-lime dosing ; and a hydraulic jack for closing the bottom valves of Robert battery diffusers.

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New Centrifugal Beet Slicer. ANON. *Sakhar. Prom.*, 1958, (1), 64–65.—The slicer includes a horizontal drum inside which is a rotor. The beets pass from a bifurcated bunker above to both sides of the rotor and are driven by centrifugal force onto the knives around the drum. The upper part of the drum contains no knives but carries provision for beet feeding if necessary.

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Treatment of Beet Juice with Decreased amounts of Lime and Ion-Exchange Resins. P. V. GOLOVIN. Z. B. SHAPOSHNIKOVA, M. A. ABRAMOVA and A. A. GERASIMENKO. *Ukrain. Khim. Zhurn.*, 1957, **23**, 397–399 ; through *S.I.A.*, 1958, **20**, Abs. 20.—Juice which has been treated with a decreased amount of lime, or with 2nd saturation juice, is agitated in a mixer with "Espatit-I" cation-exchange resin until the pH reaches 4·0–4·5. The acid juice is then separated by decantation or filtration and passed through a column of "AN-2F" anion-exchange resin, when its pH reaches 8·0–8·5. The cation-exchange treatment requires 1·5% of the dry resin on the weight of the juice, and takes 8 mintues. The weight of anion-exchange resin required is 8% on the weight of the juice. The results of a few experiments on the purification of various juices by this procedure are tabulated (absolute quantities used are not given). The treatment raises the purity of a typical juice from 1·8 to 2·5 units ; the colour is reduced by a factor of over 2.

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Pectins and Dextrans in Sugar Factory Juices. K. VUKOV. *Zeitsch. Zuckerind.*, 1958, **83**, 14–17.—The effect of pectins and dextrans on carbonatation juice filtrability was studied using a steam-jacketed pressure filter based on a design by P. M. SILIN. Two pectin preparations were used, viz. "Hatvaner" powdered beet pectin containing 50% Ca-pectate, and "Unipektin" containing 80% polyuronides. Dextran having a M.W. of several million was prepared by precipitation and drying of the precipitate from a *Leuconostoc* fermentation. The filtration rate of a 10° Brix molasses solution to which 5 g/100 ml first carbonatation muds had been added was hardly affected by up to 0·8 g/100 ml pectin and its observed effect is clearly that of increasing viscosity. Hypochlorite substantially reduced the size of the "Unipektin" particles. The filtrability was very much dependent on the method of muds formation ; the filtration (after $CaCO_3$ addition) of the precipitate obtained with 0·10% lime was poorer than that of the precipitate obtained by liming with 1·0% and carbonatation to 0·1% CaO The effect of dextran on the filtration of a 15% sugar solution over dried and powdered carbonatation muds was extraordinarily great and could not be ascribed to the increase in viscosity. Oxidation with hypochlorite reduced the relative viscosity of a 0·5% dextran solution from 1·33 to 1·27, lowering the M.W. and increasing the filtrability as a result.

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Effect of Extraction Liquor Velocity on Sugar Extraction from Beet Slices and Cossettes. C. F. DRONOV. *Sakhar. Prom.*, 1958, (2), 9–14.—Tests were made with preheated beet slices 80 × 100 mm (3 mm thick) in a laboratory diffuser at 70°C for 30 min. From the tests was derived the following formula for values of the convective diffusion coefficient (β) for diffusion liquor velocities of 5–45·7 cm/sec :

$$\beta = \frac{0{\cdot}346 \,.\, 10^{-2} D}{d_{eq}} \mathrm{Re}^{1{\cdot}057}$$

where D = coefficient of molecular diffusion of sugar from cossettes in sq.cm./sec, d_{eq} = equivalent depth, in cm, of the aperture through which the liquor flows along the beet slice, and Re = the Reynolds number given by $\frac{w.d_{eq}}{\nu}$ where w = mean velocity of extraction liquor in cm/sec, and ν = kinematic viscosity of the liquor in sq.cm./sec. Similar tests made with factory cossettes of length 14·9 m/100 g at 70°C for 10 min in a different apparatus gave the following formula for extraction liquor velocities of 1·14–7·12 cm/sec :

$$\beta = \frac{0{\cdot}0225 \,.\, D \,.\, \mathrm{Re}^{1{\cdot}355}}{d_{eq}}$$

where d_{eq} = equivalent size of pores between the cossettes in cm. From this formula it is concluded that the maximum sugar extraction is reached when the liquor velocity is increased from 1·14 to 3·96 cm/sec.

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The Total Alkalinity of 1st Carbonatation Juice. A. K. KARTASHOV, YU. D. GOLOVNYAK, N. A. MAKSIMOVA and R. G. ZHIZHINA. *Sakhar. Prom.*, 1958, (2), 15–19.—The literature on 1st carbonatation juice alkalinity is reviewed. Laboratory tests are described in which "aggregate" juice made up by mixing over- and under-saturated juice in appropriate proportions was compared with juice of normal alkalinity, obtained by gradual reduction in alkalinity of defecation juice. The results of the tests show : that variations in 1st carbonatation juice alkalinity within the range of 0·20–0·02% CaO and the formation of "aggregate" juice do not have adverse effects on the quality of the juices or of the after-products ;

that there is no indication of increased losses in the filter muds from "aggregate" juice ; and that the "aggregate" juices have better filtration characteristics than the normally de-gassed juices.

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Use of High-Frequency Vibrations in the Sugar Industry (Beet Washer). N. A. BURENKOV. *Sakhar. Prom.*, 1958, (2), 25–29.—As a result of satisfactory tests with a laboratory model, a factory vibratory washer was designed, although this has yet to be tested. The beet are fed into a sloping, vibrating pipe, suspended in a trough, against a counter-current of water fed into the other end of the pipe, which is perforated with 40–50 mm holes. The beet fall from the pipe onto an inclined conveyor and are rinsed by water from a spray near the top. The concrete bottom of the tank is inclined on each side of a hole, through which stones may be removed, and the mud can be removed by bubblers. The amplitude of vibrations of the pipe is 0·5–1·5 mm. Tests on washing filter cloths by means of vibrations showed that they were washed satisfactorily in 30–40 sec. A design for a filter-cloth washer is suggested in which the cloths are fed onto an inclined slow-moving conveyor and pass against a counter-current of water under vibratory plates. The use of vibrations for cleaning pulp-catcher screens and other pieces of machinery in the sugar factory is mentioned.

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New Scheme for Heating Barometric Condenser Water and Diffusion Juice for Sugar Factories with Rotary Diffusers. YU. M. POLYAKOV. *Sakhar. Prom.*, 1958, (2), 32–33.—Difficulties have arisen from scale formation in condensate reheaters and heat transfer has been poor. Under the new scheme the barometric condenser water is heated in a pre-condenser to 60°C and then in pressure vessels to 75°C by injection of exhaust steam from the turbines before passing to the diffusers. Pre-defecation of diffusion juice at 65–67°C without preheating led to foaming during defecation and 1st carbonatation. Two of the spare condensate heaters are consequently used to heat the diffusion juice before defecation, and one for heating de-gassed unfiltered 1st carbonatation juice. This is recycled to pre-defecation, which is carried out at 90°C. The final molasses yield in 1957 was 3·39% by weight on beet compared with 4·39% in the corresponding period in 1956.

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Briquetting of Dry Pulp and "Troblako" in the Sugar Industry. B. BRUKNER. *Zucker*, 1958, **11**, 120–121.—A press for briquetting pulp at Schleswig sugar factory is described with illustrations. The dry pulp is wetted to 12–14% moisture content on a feed screw and is then pressed by an edge runner into briquettes 18–20 mm in size. The pulp is heated during the actual pressing and then cooled to 20°C in a cooling tower. Dust picked up by the cool air is separated in a cyclone and fed back to the press. The 85 h.p. edge mill has an hourly capacity of 5·5 tons of dry pulp. The bulk weight of dry pulp is given in the literature as 200–250 kg/cu.m. (300–325 kg/cu.m. after long storage) compared with a briquetted pulp weight of 650–750 kg/cu.m. Thus the storage space required is reduced by 2·5:1 to 3:1.

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Automation at Merkensk Sugar Factory. L. P. ZEMLYAKOV. *Sakhar. Prom.*, 1958, (3), 46–51.—Automatic controls for cleaning beet-washers, stone and sand traps, for battery diffuser operation, defecation lime dosing, evaporator juice level and syrup density regulation are described and illustrated. A central control panel is used.

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The Sugar Factory at Delitzsch (East Germany). V. N. STABNIKOV. *Sakhar. Prom.*, 1958, (3), 64–67.—The factory, planned for a daily throughput of 2000 tons of beet, has been in operation since 1955. The Gek diffuser, of which there are two, comprises two 22 m long × 3 m wide tanks, one above the other, each of which is divided into sections by partitions which do not meet the bottom of the tank and so permit juice flow from one end to the other. Fresh water enters the first section and the return water the third section of the bottom tank. The V-shaped cossettes, with a length of 13 m/100 g, are passed at 10–12 m/sec along a rake conveyor over a screen surmounting the sections. They enter the top part of the diffuser via a chute and are removed by screw conveyor at the bottom. In each section the water is removed through the bottom and sprayed by pump over the cossettes. The water flows by gravity along the bottom tank and is then pumped to the top one. Retention time is 60 min, and draught is 115–125%. Losses in unpressed pulp are 0·5–0·9% with fresh beet. The diffuser has a designed capacity of 10,000–12,500 tons beet/day (*sic*). Disadvantages include : the complex conveying devices and large number of pumps requiring frequent maintenance, clogging of the screen, especially during processing of sub-standard beets, and the formation of large amounts of foam. The continuous defecators comprises a horizontal sectioned tank with a mixer in each section. The defecated juice pH is 11·2–11·4, that of the 1st carbonatation juice is 10·2–10·8 and of the 2nd carbonatation juice 8·7. Carbonatation is carried out in a continuous saturater. The clarifiers have no agitators, but each is equipped with 50 conical settling surfaces. Wolf rotary drum filters are used for 1st carbonatation muds and filter-presses for 2nd carbonatation juice filtration, the juice going to evaporation having a Brix of 13·27, 12·32 pol, 92·84 purity, and CaO content 0·0026%. The exhaust steam from the turbines goes to the triple-effect evaporator at 3·5 atm. The thick juice has a Brix of 55·28, 51·5% pol and a purity of 93·16. A three-boiling system is used, giving a molasses yield of 4% on beet, with a purity of 64·41–62·91. A 30 m dia. settling-tank in the form of a polygon is used for purifying flume and wash water. It is divided into 10 funnel-shaped tanks and has a centrally-located compressor which is used to free the mud from the water and then remove it from the settler.

NEW BOOKS AND BULLETINS

Zucker Jahrbuch 1958/59. (Sugar Yearbook.) Ed. H. HAHN. 896 pp; $5\frac{3}{4} \times 8\frac{1}{4}$ in. (Verlag ALFRED RÖPER, Schlüterstrasse 56, Hamburg 13, Germany.) 1958. Price : DM 24.00.

This reference book with its useful table of contents in English, French and German is very similar to previous editions[1]. A section covering the West German sugar factories in detail and dealing with the factories in the other countries of the world in less detail includes addresses of chemists and samplers, world trading companies, sugar importers and exporters. The sugar organizations of West Germany and of other countries are listed as well as the international organizations. Legislation and regulations concerning the West German sugar industry are given in detail, and there are statistical articles by Dr. H. MOSOLFF on the world and on the German sugar markets. A review of sugar machinery manufacturers and a Buyer's Guide with a detailed advertisers' index with subject headings end the edition. A detached supplement gives a guide to German beet prices.

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Report of the Rothamsted Experiment Station, 1957. 316 pp ; $6 \times 9\frac{1}{2}$ in. (The Rothamsted Experiment Station, Harpenden, Herts.) Price: 10s. 0d.

The major studies conducted at the Station are of a fundamental character and cover so wide a field that only few items can be briefly noted. Within the orbit of the Report fall not only the work of the Rothamsted Station itself but that of Soil Survey of England and Wales, the Woburn Experimental Station, the Research Institute of Plant Physiology at the Imperial College of Science and Technology and the Commonwealth Bureau of Soils.

A considerable body of work, covering several sections, deals with nitrogen in relation to the soil. In view of the increasing use of urea, it is noted that urea containing an appreciable amount of biuret, like calcium nitrate in heavy doses, leads to poor germination and weak early growth. A study of the exceedingly complex problems connected with the responses of free-living nitrogen fixers, of nodule organisms and a bacteriophage active against the latter, forms another approach. Botanical studies are leading to the conclusion that leaf area rather than photosynthetic efficiency is the controlling factor in producing yield; cultural practice should, therefore, be directed not only to securing maximum area but that area over the longest period of time. The Biochemistry Section is mainly concerned with the processes which convert latent into active enzymes. The hatching factor of the potato-root eelworm is also being sought. Studies of this and other eelworms and of their control are the work of the Nematology Department but, curiously, no mention is made of the predaceous fungi[2]. H. GREENE supplies a review of work on tropical soils.

A special article by R. G. WARREN discusses the residual effects of the manuring and cropping treatments in the Agdell rotation experiment. This experiment on the Agdell field, a part of the Rothamsted Experimental Farm, was commenced in 1848. The results of this long-term experiment are worthy of study. Essentially, the crop yields showed no evidence of nitrogen accumulation but considerable accumulation of phosphorus and potash.

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Przemysl Cukrowniczy w Swietle Liczb (Sugar Industry Statistics.) J. JANOTTA, E. LACHOWICZ and B. TOMCZYNSKI. (In Polish.) 96 pp; $5\frac{3}{4} \times 8$ in. (Gazeta Cukrownicza, Warszawa 1, Czackiego 3/5, Skrytka poczt. 360, Poland.) Price : 28 zloty.

This is No. 2 in the series of publications to be issued by the Library of "Gazeta Cukrownicza" and is a detailed statistical review of the Polish beet sugar industry from 1950 to 1955 inclusive. Forty pages are devoted to beet production statistics and the remainder to actual sugar production. Full details are given for each of the 76 factories, including sugar and molasses production, campaign length, cossette pol, sugar yield % beet, overall losses and in molasses, coal and limestone consumption, filter cloth life, etc. The high losses in some factories (4-5% on beet) are attributed to the inadequate repairs to machinery rather than to poor technology. A map is included.

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Annuaire Sucrier 1958. (Sugar Yearbook 1958). 458 pp; 5 × 8 in. (Soc. d'Edition des Producteurs Agricoles, Industriels et Coloniaux, 42 Rue du Louvre, Paris 1er, France.) 1958.

The latest edition of the yearbook of the French sugar industry is in the same form as its predecessor[3] and retains the thumb-indexed sections which cover the same subjects as before, but brought up to date with, for instance, the current officers of the professional association, 1957/58 data for the sugar factories described, and up-to-date figures in the section of statistics of the French and world sugar industries. In the section dealing with France's overseas territories, a new entry is given for the Niari factory in the French Middle Congo, while in a pocket of the back cover is a map showing the location of all the sugar factories and factory-distilleries of Metropolitan France. Its comprehensive scope will make this book invaluable to all concerned with the sugar industry of France and the French Union.

[1] Cf. *I.S.J.*, 1956, **58**, 229.
[2] *I.S.J.*, 1958, **60**, 31.
[3] *I.S.J.* 1957, **59**, 319.

LABORATORY METHODS AND CHEMICAL REPORTS

Method for checking Sucrose Balance in Sugar Factories. J. A. ACOSTA. *Sugar y Azúcar*, 1958, **53**, (1), 25–26.—Sucrose in cane is decreased by 4–12% before entering the mill as a result of evaporation, spillage, dirt, waste, and cane knife and shredder action. It is proposed, therefore, to allow for an 8% loss and to calculate the sucrose entering the factory as 92% of the product of cane sucrose content and weight of cane. A sucrose balance drawn up from laboratory data on sugar, molasses and filter cake gives an undetermined loss figure which should be "reasonable". If bagasse losses are not too high, a high unknown loss indicates that the figure of 8% is too low ; a low unknown loss indicates that the figure is too high.

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Polarographic Analysis of Carbohydrates. M. S. SHUL'MAN. *Sakhar. Prom.*, 1958, (1), 35–37.—The sensitivity of polarographic analysis of glucose, sucrose, maltose, xylose, arabinose and fructose was tested by adding to 10 ml of the aqueous solutions 1 ml of LiCl, $CaCl_2$ and $Ca(OH_2)$. The results, in graph form, show that where $Ca(OH)_2$ was used as electrolyte the height of the polarographic wave depended on the chemical structure of the carbohydrate under test. Sucrose and fructose can be determined easily from the amount of fructose formed after acid hydrolysis with HCl, which amount can be determined to an accuracy of $> 0{\cdot}001\%$ after neutralization with CaO. The fructose completely erases the glucose wave.

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Growth of Sucrose Crystals. N. ALBON and W. J. DUNNING. *Nature*, 1957, **180**, 1348–1349 ; through *S.I.A.*, 1958, **20**, Abs. 34.—Photomicrographs of sucrose crystals growing in pure sucrose solution or in sucrose solution with added glucose or fructose have, in all cases examined, shown growth spirals centred on screw dislocations. The steps in the growth hills were about 40 times larger in the presence of glucose, compared with those with sucrose alone or with fructose. Growth started only at an appreciable supersaturation ; it is suggested that this effect is connected with the relative dimensions of the distance between dislocation centres and of the critical surface nucleus. Owing to the varying activities of the growth centres, rates of vertical growth (at the same supersaturation) were different on equivalent faces of different crystals. On any one growth hill the rate of movement of steps was constant, and was a function of the solution concentration. On reducing the concentration to saturation or just below, small etch pits, often in linear arrangement, appeared at the ends of dislocations.

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Crystallized Compounds of Sucrose with Sodium and Sodium Carbonate. J. DUBOURG, A. LEMAITRE and R. SAUNIER. *Ind. Alim. Agric.*, 1958, **75**, 11–12.—Four 80° Brix solutions containing various proportions of sucrose and NaOH were prepared at about 80°C. After some days in steam-tight vessels in an oven at 55°C crystals were found in the form of needles. These were recovered in two successive crystallizations, the relationship Na atoms/sucrose mol. being determined each time. The successive re-crystallizations yielded products whose relationship tended towards 1, corresponding to a starting solution formula of $C_{12}H_{22}O_{11}$,NaOH. Similar experiments were made with sodium carbonate, when crystals formed which, after recrystallization, tended to contain 2 atoms of Na to 1 mol. of sucrose, whether the starting solution had a ratio lower or greater than 2. One mol. of CO_2 was found per mol. of sucrose contained in these crystals. Treatment of a solution of the sucrose + NaOH crystals with CO_2 gave crystals which were successively crystallized, showing a tendency towards a ratio of 2 atoms Na to 1 mol. sucrose.

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Synthesis and Accumulation of Sucrose in the Sugar Beet. A. L. KURSANOW. *Zeitsch. Zuckerind.*, 1958, **83**, 78–80.—The subject is reviewed with 22 references to the literature. Tests have indicated that sucrose is formed during photosynthesis from glucose and fructose in the leaves and that practically no synthesis from these sugars takes place in the root or stem of the beet, except in very young roots with a weight of 10–20 g where the rate of synthesis is no more than 7% of that in the leaves.

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Studies in the Chemistry of Sulphitation. III. A. CARRUTHERS, J. F. T. OLDFIELD and A. E. WOOTTON. *Paper presented to the 11th Tech. Conf., British Sugar Corp.*, 1958.—An analytical technique has been developed for the determination of imidodisulphonates in sugar factory products; bisulphites are neutralised by adding formaldehyde and then sodium nitrate is added to the liquor. This converts the imidodisulphonate to sulphate which is determined gravimetrically with $BaCl_2$. Omission of the nitrate addition gives the sulphate originally present and the imidodisulphonate is thus found by difference. It is demonstrated that the salt occurs in all juices and syrups subsequent to sulphitation (and sometimes in sugar) and is formed as a result of reaction between SO_2 (as bisulphite ions) and nitrites formed by bacterial reduction of nitrates[1]. The loss of SO_2 is estimated as equivalent to a wastage of 2–20 lb of sulphur per 100 tons of beet out of a total usage of say 60 lb.

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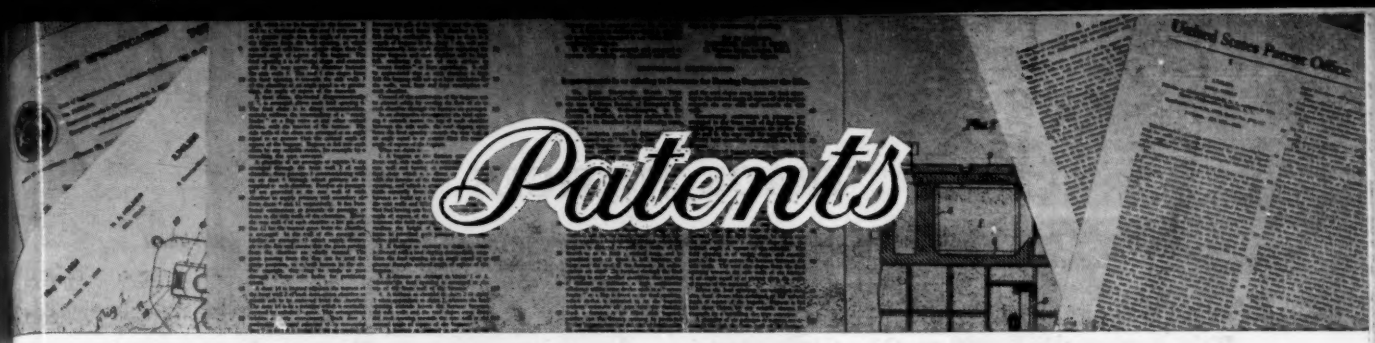
Automatic Pipette for Digestion. A. A. GROKHOVSKII. *Sakhar. Prom.*, 1958, (2), 54–55.—A modified automatic pipette for beet analysis, which has been successfully tested, is described and illustrated. The improvements are designed to reduce the decomposition of lead acetate when this is exposed to the air.

[1] See *I.S.J.*, 1958, **60**, 335.



UNITED STATES.

Pith-Free Paper Pulp from Bagasse. H. D. STUCK, assr. PROCESS EVALUATION AND DEVELOPMENT CORP., of New York, N.Y., U.S.A. **2,839,398.** 27th September 1952; 17th June 1958.—Bagasse is treated for 10 min at 60–75°C with an aqueous solution of carbohydrate-active or protein-active enzymes which are stable at that temperature in order to loosen the pith cells from the fibre bundles. It is agitated violently to detach the pith cells from the fibre bundles, which are then digested, in a solution comprising initially about 3% by weight of NaOH and 1·5% sodium sulphide, 2–5% of sodium peroxide with a stabilizer, about 0·2–1% ammonium nitrate and a non-ionic wetting agent, for about 4 minutes at a saturated steam pressure of about 150 p.s.i.g. The unabsorbed solution is drained off and an aqueous solution of 1·0–2·5% sodium pyrophosphate peroxide added. Digestion is continued under a saturated steam pressure of 175 p.s.i.g. and terminated by suddenly releasing the pressure to cause an explosive expansion of the fibre bundles to pulp.

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Cane Planters. (1) R. J. ANDERSON, of Labadieville, La., U.S.A. **2,840,269.** 14th September, 1953 ; 24th June, 1958. (2) J. G. ARCENEAUX, of Chamberlin, La., U.S.A. **2,841,103.** 17th June, 1954 ; 1st July, 1958.

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Cane Harvester Pick-up Attachment. B. C. THOMSON and P. F. OSWALD, assrs. THOMSON MACHINERY COMPANY, of Thibodeaux, La., U.S.A. **2,840,973.** 22nd August, 1956 ; 1st July, 1958.

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Beet Harvester Rotatable Sorting Table. V. F, BOZEMAN, K. B. SORENSON, C. S. MORRISON and B. E. KENT, assrs. DEERE & CO. INC., of Moline, Ill,, U.S.A. **2,842,265.** 16th July, 1954 ; 8th July, 1958.

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Recovery of Barium Saccharate and Glutamic Acid from Beet Molasses. J. L. SHELTON, of San Jose, Calif., U.S.A., assr. INTERNATIONAL MINERALS & CHEMICAL CORP. **2,842,591.** 15th November, 1955 ; 8th July, 1958.—Beet molasses is treated with at least 60% (65–85%) by weight of BaO on weight of sucrose present, in an aqueous medium containing 40–70% dry solids content, exclusive of the BaO, at a temperature of 60–85°C for a period of ½–5 hours, depending inversely on the temperature employed. The barium saccharate precipitate is separated and washed with dilute BaO solution, 80–100% of the washings being added to further molasses. Between 0·4 and 3% of an alkali metal hydroxide is added to the barium saccharate mother liquor, in which the glutamic acid precursors have been hydrolysed by the foregoing treatment, and the pH lowered to 8–10 by passing a CO_2-containing gas through it. The $BaCO_3$ precipitate is separated and the glutamic acid either recovered or rendered stable by adjusting the pH to 7.

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Glutamic Acid Recovery. F. A. HOGLAN, of Glenview, Ill., U.S.A., assr. INTERNATIONAL MINERALS & CHEMICAL CORP. **2,842,592.** 12th December, 1956 ; 8th July, 1958.—Concentrated Steffen's filtrate or barium filtrate is adjusted to 25–55% solids, hydrolysed by heating with $Ba(OH)_2$ or $Sr(OH)_2$ at 65–100°C and neutralized with CO_2 to pH 8–12. The alkaline earth carbonate precipitate is separated and the pH adjusted to 4·5–5·5 with sulphuric acid. On concentration to 60–90% by weight of the original filtrate, salts are rendered insoluble ; they are separated and glutamic acid separated from the mother-liquor by adjusting to pH 3·2 with sulphuric acid.

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Animal Feed Material. R. BART and W. B. WILLIAMS, of Lakeland, Fla., U.S.A., assrs. INTERNATIONAL MINERALS & CHEMICAL CORP. **2,843,492.** 25th November, 1955 ; 15th July, 1958.—Cane or beet molasses containing a uniform dispersion (2-20% by weight) of a solid particulate calcium mono-, di- or triphosphate of 325-500 mesh size is claimed to be suitable for animal feeding.

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Revivifying Carbonaceous Adsorbents. T. B. WAYNE, of Houston, Texas, and J. A. MCLELLAN, of Garden City, Texas, **2,851,428.** 8th March 1956; 9th September 1958.—A bed of loose, granular spent bone char, "Synthad," or other carbonaceous adsorbent is revivified by passing upwards through it heated gases at a high enough velocity to fluidise the bed, but not so high as to carry off any adsorbent. The temperature and oxidising gas content are so chosen as to evaporate all the water in the adsorbent and to oxidise the impurities on the surface while not substantially oxidising the permanent surface-active carbon. The adsorbent is cooled in a non-oxidizing atmosphere to a temperature below that at which it will burn in air.

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

Plain Bearings which need no Oil. Glacier Metal Co. Ltd., Alperton, Wembley, Middx.

Three new "dry" bearing materials include the DU material which comprises thin steel strip with a porous bronze coating impregnated with a mixture of lead and polytetrafluoroethylene (P.T.F.E., "Fluon" or "Teflon")—a fluorocarbon plastic. A stock range of bushes, thrust washers and flat strip is available. The DQ material is P.T.F.E. strengthened with special fillers and is supplied in bars or tubes from which non-standard dry bearings may be machined. The DM material describes an adherent layer, about 0·0015–0·0025 inches thick, of a combination of P.T.F.E. and molybdenum disulphide which may be applied to the bearing surfaces of parts sent to the Glacier Company for treatment.

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MS4 Silicone Compound. Holiday & Hemmerdinger Ltd., 71 Ardwick Green North, Manchester 12.

This product is an insulating and waterproofing compound with the consistence of petroleum jelly. It is stable from —50° to 200°C and can be applied by brushing, wiping or by spraying in the form of a dispersion in carbon tetrachloride. It is especially suitable for insulation of electrical equipment and, besides acting as a lubricant for cables being drawn through conduit, acts as an anti-oxidant, so preserving the flexibility of natural and synthetic rubber insulation. It repels moisture and makes surfaces water-repellent and maintains a high surface resistivity under highly humid conditions. It also combats corrosion and prevents sticking of machined surfaces and gaskets.

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New Diesel Locomotive. Motor Rail Ltd., Simplex Works, Bedford.

The new 30 h.p. "Simplex" locomotive is powered by a two-cylinder water-cooled direct injection oil engine which is governed over its speed range of 380—1800 r.p.m. and has its engine, clutch and gearbox mounted transversely in the centre of and parallel to the driving axles for greater safety on uneven tracks. The final drive to each axle is by adjustable heavy roller chain, and the dust-proof axle-boxes are fitted with removable gunmetal bearings lubricated by wick feeder from an oil reservoir. A lever-brake system acts on all four wheels.

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Louisiana Cane Harvest Procedure. Logan Perkins, International Trade Mart, New Orleans, La., U.S.A.

A leaflet, available in English, Spanish, Portuguese and French, describes the advanced state of mechanization in Louisiana cane harvesting, mentioning the equipment in use. Two-man harvesters open their way through a canefield at about 3—3½ m.p.h. cutting one row at a time, and piling 7 to 8 rows in one heap row. In continuous operation the machines cut and pile 10—15 acres per day. The heaps are then burnt to remove excess trash and then loaded onto 3-ton cane carts by tractor-mounted units having a push-piler and a swing-boom mounted cane grab. The cane carts are formed into trains for hauling by tractors to the sugar factory. Other equipment used in the off-season are the stubble shaver and the ditching attachment for maintenance of old ditches and digging of new ones.

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PUBLICATIONS RECEIVED

CONVEYOR BELT IDLERS. Link-Belt Company, Prudential Plaza, Chicago 1, Ill., U.S.A.

An expanded new line of belt conveyor idlers from Link-Belt includes five series in widths ranging from 14 to 84 inches. Flat, 20° and 45°-troughed idlers and variable troughed idlers are available, as well as rubber-cushioned idlers and positive action and actuating disc training idlers.

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VAUGHAN PRODUCTS. The Vaughan Crane Co. Ltd., Manchester 12.

A leaflet illustrates some of the range of Vaughan cranes—overhead travelling and wall jib types ; electric hoist blocks and pulley blocks, and telpher systems.

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DRYTUBE DUST FILTERS. Dallow Lambert & Co. Ltd., Thurmaston, Leicester.

"Drytube" dust filters are fabric sleeves, with high collection efficiency and low maintenance costs. They are made in three types and a standard range of sizes. Illustrations show various applications—in a foundry, plastics and rubber factories, etc.

* * *

PNEUMATICALLY OPERATED SLIDE VALVE. W. S. Barron & Son Ltd., Gloucester.

The Barron pneumatically-operated slide is described as clean, positive, instantaneous and trouble-free. It may be remote-controlled either electrically or manually and can be operated either fully open or shut; with intermediate positioning; or with an inching or reciprocating action, e.g. for use on a feeder to a weighing machine. Runner bars prevent build up of material and the slide can be totally enclosed. Sizes range from 6 inches square to 14 inches square.

* * *

THE "STICLA" BAG-SEALING MACHINE. The Thames Sack & Bag Co. Ltd., 28 City Road, London E.C.1.

The new "Sticla" machine seals paper sacks of up to 56 lb capacity horizontally by means of an adhesive strip which covers both sides of the opening and may be opened by means of a nylon rip-cord running the length of the seal. The seal is guaranteed to be stronger than the surrounding material.

* * *

O-RING ROTAMETERS. Brooks Rotameter Company, Lansdale, Pa., U.S.A.

The new O-ring seal type of rotameter described in Specification sheet SS-111-2 features "Teflon" (P.T.F.E.) tube adaptors designed to permit easy removal and interchange of different size metering tubes. The Specification sheet gives full design, capacity and dimension details.

ICUMSA

President : H. C. S. DE WHALLEY

Two new National Committees have been affiliated and registered by the Secretary.

Cuba gave notification at the Washington meeting and a detailed list of members has followed :

Professor JULIO C. GONZÁLEZ MAÍZ (Chairman); Professors MARIO A. MASCARÓ, ROBERTO GONZÁLEZ-RIVERA, JOSÉ R. DE LA VEGA; Sugar Chemists RAUL E. DRAJI, Dr. CÉSAR A. FORN, RAFAEL PEDROSA PUERTAS, JOSÉ M. LÓPEZ OÑA, MAXIMILIAN GONZÁLEZ, ING. JOAQUÍN D. MARINELLO, and ING. CUADRA AGUIRRE (who has been specially appointed by the Ministry of Agriculture to represent the Cuban Government).

More recently the composition of the Indian National Committee has been given as follows :

Dr. DESRAJ NARANG, President of the Sugar Technologists' Association of India (Chairman); Dr. N. C. VARMA, Secretary of the S.T.A.I. (Hon. Secretary); SHRI S. N. GUNDU RAO, Ministry of Food & Agriculture; Dr. S. MUKHERJEE, Professor of Sugar Chemistry, National Sugar Institute, Kanpur; Shri J. M. SAHA, Indian Sugar Mills Association; Shri C. N. MODAWAL, Indian Standards Institution; Shri H. N. S. AWASTHY, S.T.I.A.; Shri R. G. PRADHAN, Deccan Sugar Technologists' Association; Dr. P. K. KYMAL, Technical Adviser and Secretary, Technical Standards Committee, Ministry of Food & Agriculture; Dr. SATYA PRAKASH, U.P. Scientific & Research Committee; The Secretary, Development Council for Sugar Industry, Ministry of Food & Agriculture; Dr. B. K. MUKHERJI, Director, Indian Institute for Sugar Cane Research, Indian Central Sugar Cane Committee.

This good news is followed by sad news from Washington, D.C., where FREDERICK J. BATES, Life Honorary President, died at his home on 1st November at the age of 81. An obituary notice will be published next month.

Pakistan Order for Dutch Factories.—It is reported[1] that a combine of the two leading Dutch engineering works (V.M.F. Stork-Werkspoor) has received an order from the Pakistan Industrial Development Corporation for the supply and erection of two 1500-ton carbonatation factories, each capable of expansion to 2000 tons and including the boilers and turbo-generators.

* * *

Pneumatic Sugar Thrower.[2]—A pneumatic thrower which is an independent unit, not attached to any gantry or fixed loader, has been tested at Cairns in Queensland recently. Sugar from gantry chute, pipe or from bags opened over the hatch, falls across a swift current of air produced by a blower fan, and is thus distributed to any part of the ship's hold.

* * *

Increase in Polish Sugar Factory Capacities.[3]—Extension of several sugar factories in Poland has increased the industry's capacity by 15,000 tons per day. It is thought that the planned production of 1,060,000 tons could be achieved in spite of late drilling because of the beneficial effects of improved weather.

BREVITIES

Sugar Production in Colombia.[4]—Colombian sugar production in 1957 amounted to only 251,000 short tons or 30,000 tons less than in the previous year. About 33,000 tons of sugar were imported, mostly from Venezuela. The generally insufficient domestic supply of sugar has stimulated cane planting and it is expected that production in 1958 will expand to about 290,000 short tons which will make imports unnecessary.

* * *

Indian Sugar Export Losses.[5]—At the prevailing prices of sugar in the world market, the loss on exported sugar was estimated at £18 to £20 per ton, according to the Minister of Food and Agriculture on 12th August. The loss, when spread over the stocks available with the industry, at the time when the export policy was announced, works out at about 8 annas per maund (just over 0·1d. per lb) which could be made up from internal sales.

* * *

Egypt Imports and Exports, 1957.[6]—Raw sugar imported during 1957 totalled 28,238 metric tons, all from Brazil. Of the refined sugar imports of 10,675 tons, 6597 were from Eastern Germany and 4066 from Czechoslovakia, 8 from the U.K., 2 from Italy and 1 each from Lebanon and Saudi Arabia. Exports during 1957 totalled 17,360 metric tons (19,289 tons, raw value), including 7000 tons to Morocco, 7220 tons to Sudan, 1000 to Saudi Arabia, 1500 to Jordan and 640 to the Gaza strip area of Palestine.

* * *

U.K. Sugar Board Report.—The change from State to private trading in sugar, from 1956, has worked successfully, according to the first report of the Sugar Board. The Board's duty is to carry out the Government's obligation to Commonwealth sugar producers under the Commonwealth Sugar Agreement and to meet Government Guarantees to the British Sugar Corporation; it buys from these suppliers at agreed rates, sells at world prices and offsets any loss or profit by means of surcharges and distribution payments. From 15th October 1956 to 30th June 1958 there was a net outgoing of £10,200,000 on the purchase and resale of more than 2,250,000 tons of Commonwealth sugar and nearly £1,000,000 on 1,250,000 tons of domestic beet sugar. The surcharge raised £11,400,000 which was offset by £7,800,000 in distribution payments. An under-recovery of about £7,600,000 was carried forward, this being much less than the £25,000,000 the Board was allowed to borrow to avoid frequent changes in surcharge.

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New Turbine Drive in Queensland.[7]—This season the largest mill drive steam turbine in the Australian sugar industry commenced operation in the Fairymead Sugar Company's factory at Bundaberg. The turbine is coupled to a totally enclosed reduction gearbox. It is designed to transmit 1200 h.p. and reduce from a turbine speed of 4000 r.p.m. to 89 r.p.m. The gearing is of the double helical type with its own lubricating system and the main spindles mounted on roller bearings. The 4000 r.p.m. spindle is, however, carried on two white metal bearings and lubricant is force-fed. The high speed coupling was supplied from the U.K. while the slow speed coupling was manufactured by Walkers Ltd. of Maryborough, Queensland. The final reduction consists of a primary train coupled to two main driving pinions which in turn mesh with two spur wheels; the arrangement thus transmitting 600 h.p. each to two 78-inch mills. One of these is an old mill but the other is of a new design and will be operated first with only the delivery roller hydraulically loaded while the feed and top roller are fixed. The design, provides, however, for hydraulic loading of all three rollers.

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[1] *Foreign Trade*, 1958, **110**, (6), 20.
[2] *Australian Sugar J.*, 1958, **50**, 510.
[3] C. Czarnikow Ltd., *Sugar Review*, 1958, (370), 153.
[4] F. O. LICHT, *International Sugar Report*, 1958, **90**, (Supp. 19), 8.
[5] *Indian Trade J.*, 1958, **205**, 575.
[6] *Willett & Gray*, 1958, **82**, 402.
[7] *Australian Sugar J.*, 1958, **50**, 495, 497.

BREVITIES

Belgian Congo Factory.[1]—Sugar consumption in the Belgian Congo rose from 24,500 tons in 1955 to 26,000 tons in 1956 and again to 28,000 tons in 1957. It is assumed that the main reason for this development is the rising purchasing power of the population. As one sugar factory was no longer able to meet the domestic market requirements, a second enterprise, founded some time ago, has constructed the building for another factory, the machinery for which will be supplied by Belgium, France and Sweden. A sugar silo of 12,500 tons capacity is also being built at the factory. The Company had intended to harvest cane this year from 700 hectares, but so far only 500 hectares have been planted.

* * *

Cuban Sugar Crop 1958.[2]—The 1958 sugar crop totalled approximately 6,025,000 Spanish long tons of which 5,610,029 tons were raw sugar, 34,326 tons green sugar for animal feed, 30,985 tons in the form of liquid sugar, and 350,000 tons of sugar equivalent were represented in the 87,492,020 gallons of high-test molasses produced from surplus sugar cane. After producing the 1958 sugar crop Cuba still had approximately 440,000 acres of stand-over cane. Trade and Government circles estimate that under normal conditions the country can produce a minimum of 6 million Spanish long tons of sugar in 1959 if permitted by Government decree. In 1958 the raw sugar crop was officially limited to 5·6 million tons.

Stock Exchange Quotations

London Stocks (*at 17th November* 1958)

	CLOSING MIDDLE
Anglo-Ceylon (5s)	16/9
Antigua Sugar Factory (£1)	21/9
Booker Bros. (10s)	23/9
British Sugar Corp. (Ltd. (£1)	17/9
Caroni Ord. (2s)	4/3
Caroni 6% Cum. Pref. (£1)	18/3
Distillers Co. Ltd. (6s. 8d units)	30/6
Gledhow Chaka's Kraal (£1)	64/6
Hulett & Sons (£1)	83/–
Jamaica Sugar Estates Ltd. (5s units)	7/3
Leach's Argentine (10s units)	7/6
Reynolds Bros. (£1)	52/–
St. Kitts (London) Ltd. (£1)	54/6
Ste. Madeleine (Ord.) (£1)	27/9
Sena Sugar Estates (10s)	25/–
Tate & Lyle (£1)	71/–
Tate & Lyle Investments Ltd. (5s)	15/1½
Trinidad Sugar (5s stock units)	11/9
United Molasses (10s stock units)	34/9
West Indies Sugar Co. Ltd. (£1)	27/9

New York Stocks (*at 15th November* 1958)

	CLOSING MIDDLE $
American Crystal ($10)	37½
Amer. Sugar Ref. Co. ($100)	34
Central Aguirre ($5)	21
Cuban American ($10)	28⅜
Great Western Sugar	28⅜
South P.R. Sugar	26
United Fruit Co.	46½
West Indies Sugar Corp. ($1)	54⅜

Jamaica Sugar Crop 1958.[3]—The final outturn of the 1958 crop amounts to 332,975 tons, compared with 359,067 tons for last year. The latest estimate for the 1959 crop is 390,450 tons.

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German Imports of Sugar Beets to Cease.[4]—Imports of foreign beets are to cease in the campaign year 1959/60 in view of the high domestic production in 1958/59 and import commitments for 1958/59 and 1959/60.

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Sugar Beet in Pakistan.[5]—For the first time in the history of the Pakistan sugar industry, sugar beets for commercial purposes were harvested from about 300 acres in a Northern part of West Pakistan. The beets were processed along with cane.[6]

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Sugar Beet in Hawaii.[7]—Hawaiian Commercial and Sugar Co. are growing sugar beets in Hawaii on a trial basis as part of a test programme to see if rotation of various crops might increase the sugar yield of H.C. & S. land.

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Tunisia—Sweden Trade Agreement.[8]—Under the terms of a trade agreement signed in Tunis details of which were released on 30th September, Sweden indertakes to export 5000 tons of sugar to Tunisia during the year April 1958—March 1959.

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Nicaragua Sugar Crop 1957/58.[9]—According to *Foreign Commerce Weekly*, the 1957/58 crop is estimated at 57,550 metric tons of sugar. As compared with this figure, the domestic consumption is estimated at 34,500 tons as a maximum while the World and U.S. quotas amount to 5000 and 12,594 tons respectively. This leaves a surplus of 5000 tons which is causing some trouble as it is expected to be expanded by a further crop increase in 1958/59.

* * *

Cane Wax in India.[10]—Two sugar factories are producing crude cane wax, their total capacity being about 600 lb/day during the season. A process for refining and modification of the wax is reported to have been worked out at the National Chemical Laboratory, Poona. Essentially, the crude wax is oxidised with potassium or sodium dichromate and sulphuric acid, and modified by preparation of its esters and amide derivatives. The oxidation, under proper conditions, raises the acid value of the wax and chemical modification gives the wax the required properties such as solvent take-up.

* * *

Canadian Factory Improvements.[11]—Modernization at Wallaceburg factory of Canada and Dominion Sugar Co. Ltd., involving an expense of $500,000, includes a new automatic coal handling and pulverising system for the boiler house; a new runway for beet reception; a new 34-ft Fairbanks-Morse platform scale, scale house and approaches; a high-pressure evaporator (the first of five such), together with a continuous diffuser which is contemplated for future installation. At Chatham factory improvements include a runway extension, a new 50-ton scale which will be necessary for weighing bulk sugar and molasses trucks, an additional beet piler, and automatic "Tare takers". Preparations for bulk sugar delivery include erection of two 60-ton tanks.

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[1] *Zucker u. Süsswaren Wirtsch.*, 1958, **11**, 890.
[2] *Willett & Gray*, 1958, **82**, 446.
[3] C. Czarnikow Ltd., *Sugar Review*, 1958, (379), 190.
[4] F. O. Licht, *International Sugar Report*, 1958, **90**, (Supp. 20), 2.
[5] F. O. Licht, *International Sugar Report*, 1958, **90**, (9), 12.
[6] *I.S.J.*, 1958, **60**, 38.
[7] *Cubelet Press*, 1958, **23**, (15), 2.
[8] C. Czarnikow Ltd., *Sugar Review*, 1958, (379), 191.
[9] F. O. Licht, *International Sugar Report*, 1958, **90**, (Supp. 21), 12.
[10] *Indian Sugar*, 1958, **8**, (5).
[11] *Up and Down the Rows*, 1958, (118), 8–10.